C47B

MAINTENANCE MANUAL

DOUGLAS AIRCRAFT CO., INC. SANTA MONICA, CALIF., U.S.A.

HANDBOOK

ERECTION AND MAINTENACE INSTRUCTIONS

USAF SERIES

C-47, C-47A, C-47B

NAVY MODELS

R4D-1, R4D-5, R4D-6, R4D-7

AIRCRAFT

PUBLISHED BY

DOUGLAS AIRCRAFT CO., INC. SANTA MONICA, CALIF., U.S.A.

15 October 1944
REVISED 5 MAY 1952

TABLE OF CONTENTS

Section *Page*

I Description, Dimensions, and Leading Particulars 1
  1. Description 1
  2. Principal Dimensions and Leading Particulars 1

II Shipment and Erection Procedure 5
  1. General 5
  2. Wing, Empennage, and Control Surfaces 6
  3. Landing Gear 6
  4. Engine 6
  5. Propellers 8
  6. Rubber and Synthetic Rubber Parts 8
  7. Glass and Plexiglas 8

III Handling and General Maintenance Instructions 10
  1. Access and Inspection Provisions 10
  2. Ground Handling 10
  3. Servicing Instructions 35
  4. Lubrication Requirements 41
  5. Special Tools and Equipment 44
  6. Ground Operating Instructions 67

IV Major Component Parts and Installations ... 73
  1. Wing 73
  2. Empennage 84
  3. Fuselage 86
  4. Landing Gear 88
  5. Engine Section of Nacelle 136
  6. Power Plant 141
  7. Propellers and Controls 185
  8. Starting System 207
  9. Oil System 210
  10. Fuel System 228
  11. Instruments and Automatic Pilot 248

Section *Page*

  12. Surface Controls 287
  13. Hydraulic System 319
  14. Electrical System 413
  15. Communications Equipment 480
  16. Furnishings 509
  17. Engine Fire Extinguisher System 522
  18. Heating and Ventilating Systems 525
  19. Ice Elimination Systems 551
  20. Oxygen Systems 587
  21. Fire Detection System 600C

V Useful or Military Load Installation 601
  1. Transport and Cargo Provisions 601
  2. Navigation Provisions 622
  3. Pyrotechnics 623

VI Materials of Construction 625

VII Finish Specifications 638
  1. General 638
  2. Cleaning 638
  3. Protective Finishes 639
  4. Thread Lubricants 641
  5. Line Identification 641
  6. Identification of Control Knobs 641
  7. Electrical Bonding 641
  8. Spot Welding 641

VIII Tubing Charts 644

IX Charts and Tables 715
  1. Instructions for Using Cable Manufacturing Chart 715
  2. Cable Manufacturing Chart 717
  3. Special Torque Value 721

X (Deleted)

Alphabetical Index 765

Appendix I Operation and Service Instructions for Airplane Skis, Models AWSR-3100, AWSR-3100-1 and WST-3000 771

Figure 1—C-47's in Flight

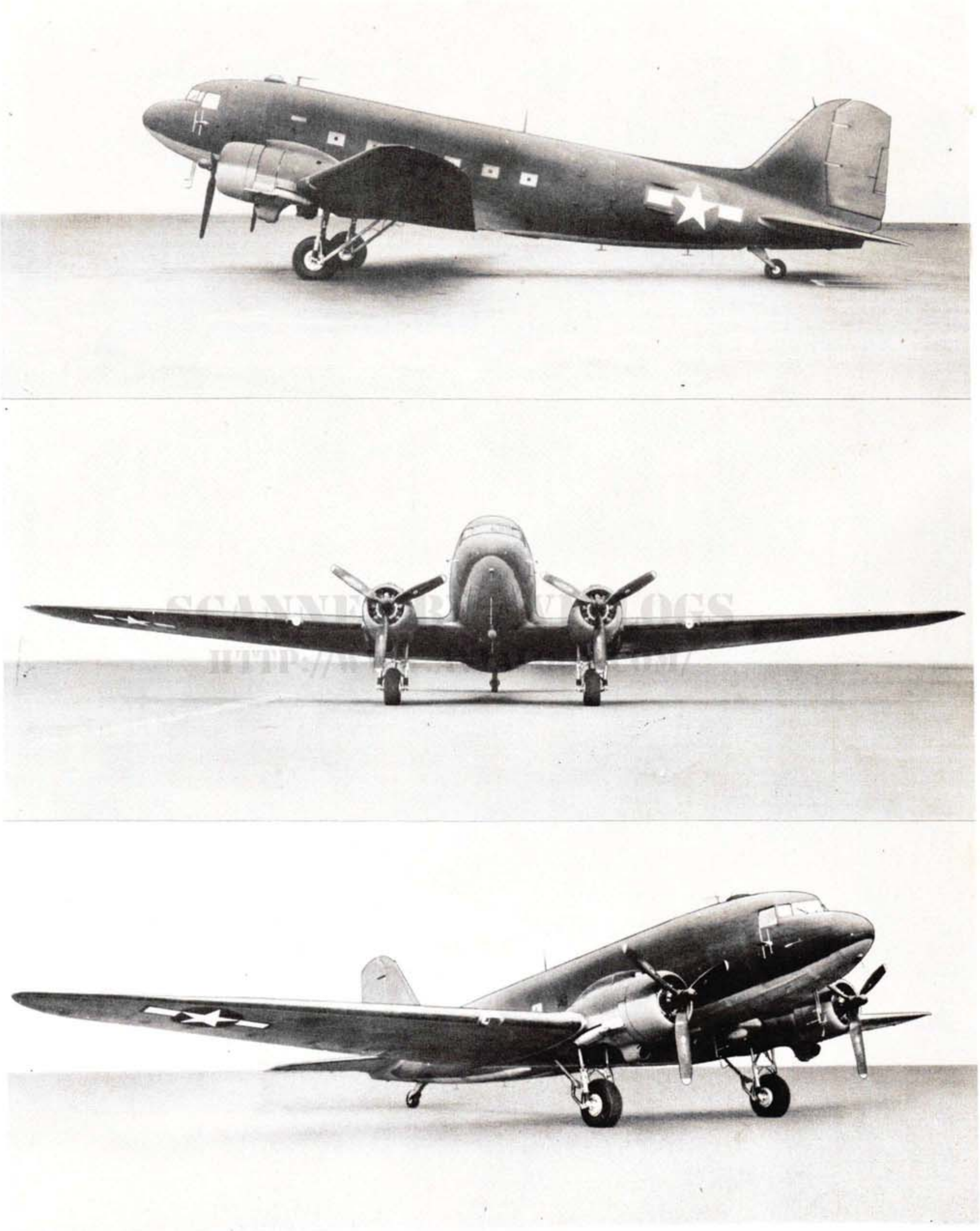


Figure 2—Left, Front, and Front Three-Quarter Views

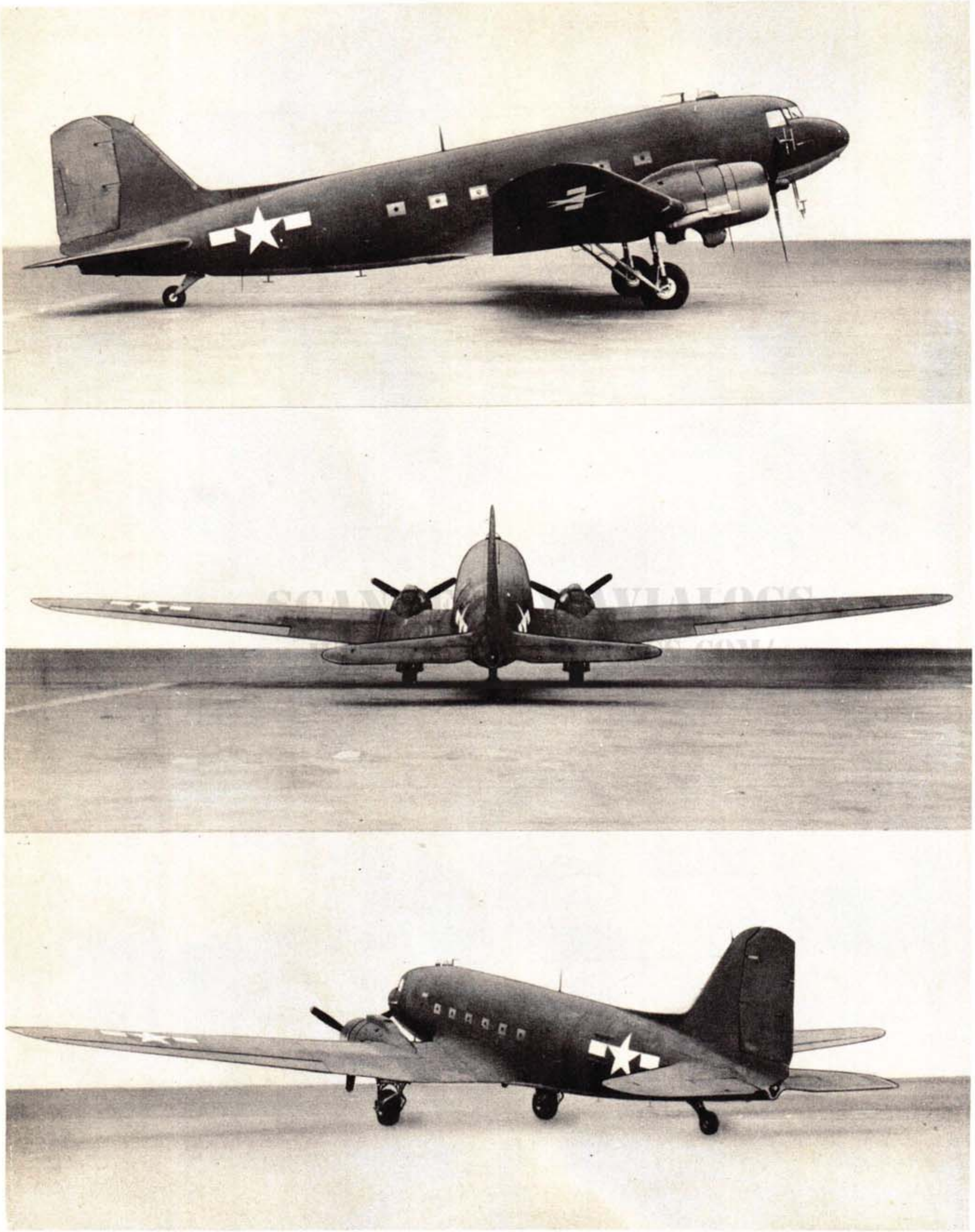


Figure 3—Right, Rear, and Rear Three-Quarter Views

SECTION I

DESCRIPTION, DIMENSIONS, AND LEADING PARTICULARS

1. DESCRIPTION.

C-47, C-47A, and C-47B (R4D-1, R4D-5, and R4D-6) airplanes are low-winged, two-engine monoplanes of all-metal, semi-monocoque construction. Their primary function is the transportation of materiel and personnel, including paratroopers, wounded troops, and the towing of gliders. The overall span is 95 feet, overall length is 64 feet, 5½ inches, and height with tail wheel on the ground is 17 feet. Provision is made to accommodate a crew of five, including the pilot, copilot, radio operator, navigator, and flight engineer. On some airplanes provisions are omitted for the navigator and flight engineer. Folding benches for 27 passengers are installed along both sides of the main cargo compartment. A variety of loading provisions permits transport of engines, heavy artillery, and other equipment. Installation of litters may be used for the transportation of the wounded. A glider tow arrangement is provided on some airplanes for pulling one or more gliders. Propellers and parapack racks may be carried underneath the fuselage.

2. PRINCIPAL DIMENSIONS AND LEADING PARTICULARS.

(Aircraft in level flight position unless otherwise noted.)

GENERAL	
Span	95 ft
Length (with tail cone)	64 ft 5½ in.
(with glider tow)	63 ft 9 in.
Height	14 ft 11½ in.
Height (tail wheel on ground)	16 ft 11⅛ in.
WINGS	
Airfoil section (curve identification)	at root NACA 2215 at tip NACA 2206
Chord at root	170 in.
Chord near tip (wing station 398)	56 in.
Incidence	2 degrees
Dihedral (measured at top of front beam)	5 degrees
Sweepback (outer wing panel at station 123)	15½ degrees
STABILIZER (horizontal)	
Span	26 ft 8 in.
Maximum chord	80.7 in.
Incidence	0 degrees
Dihedral	0 degrees
FUSELAGE	
Width (maximum)	8 ft 1¼ in.
Height (maximum)	8 ft 8½ in.
Length	63 ft 9 in. or 64 ft 5½ in.
AREAS	
Wings (less ailerons)	884.2 sq ft
Wings (with flaps extended) (less ailerons)	884.2 sq ft
Ailerons (total)	104.7 ft
Flaps (total)	82 sq ft
Stabilizers (including elevators)	179.2 sq ft
Elevators—two (including tabs)	83.4 sq ft
Elevator trim tabs (total)	3.6 sq ft
Fin	37.9 sq ft
Rudder (including tabs)	46.6 sq ft
Rudder trim tabs (total)	3.0 sq ft
Aileron tab	1.91 sq ft

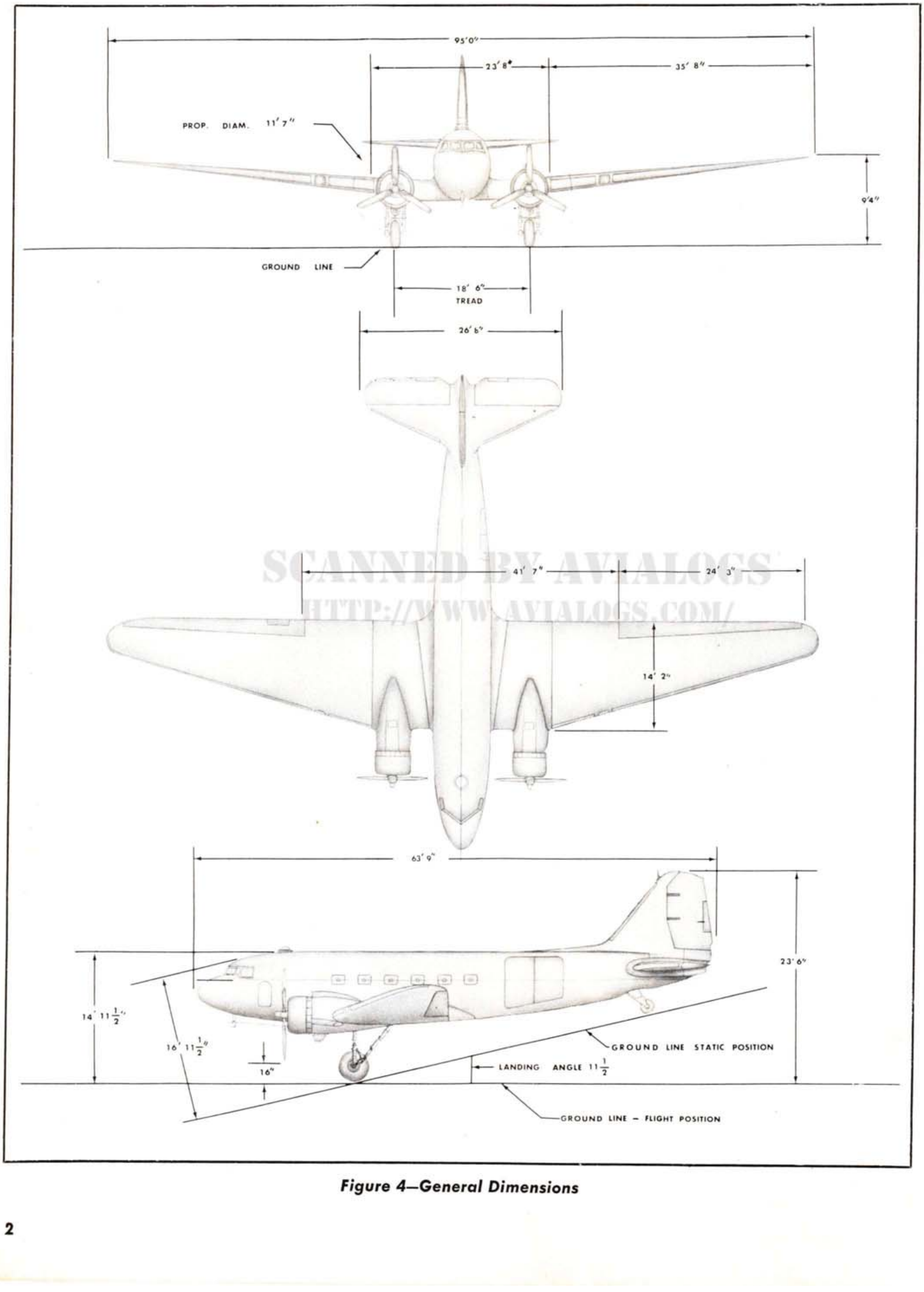

95'0"
23' 8*
35' 8"
PROP. DIAM. 11' 7"
9'4"
GROUND LINE
18' 6"
TREAD
26' 6"
41' 7"
24' 3"
14' 2"
63' 9"
23' 6"
14' 11 1/2"
16' 11 1/2"
16"
GROUND LINE STATIC POSITION
LANDING ANGLE 11 1/2
GROUND LINE – FLIGHT POSITION

Figure 4—General Dimensions

LANDING GEAR

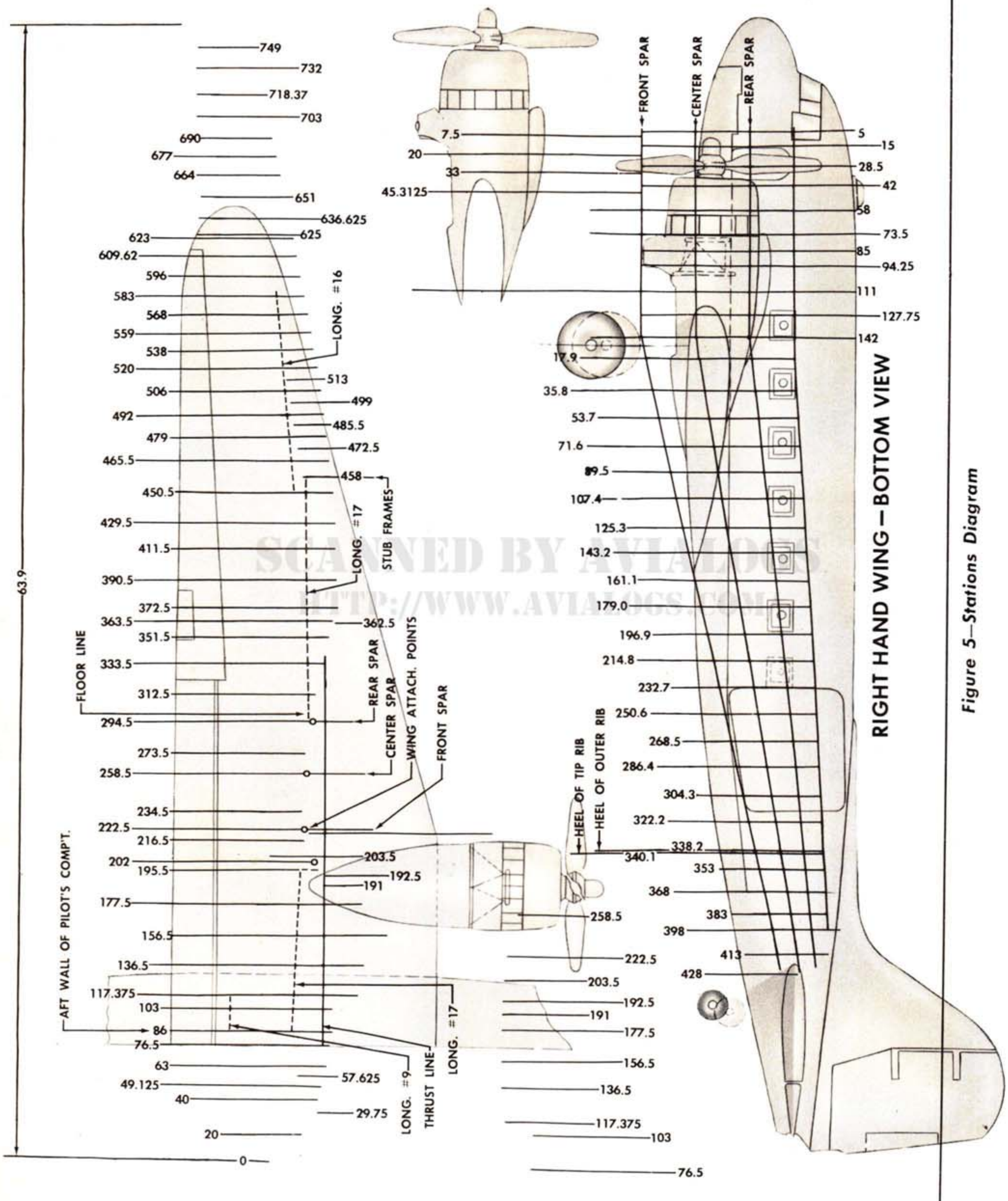
MAIN GEAR	
Type	Hydraulically actuated, retractable
Tread (width from center of tire to center of tire)	18 ft 6 in.
Shock struts	
Type	Air-oil
Make and part No.	Bendix, 65900
Fluid	
Specification No.	AN-VV-O-366
Air pressure	Must be determined by extension of strut. See paragraph 13.*c*.(5)*(c)*, section IV.
Wheels	
Type	Bendix B1 or B3, 17:00 x 16, Aluminum
Part No. (assembly)	5116415
Tires	45 x 17:00 x 16 10-ply
Air pressure	Must be determined by deflection. See paragraph 4.*b*.(7)*(c)*, section IV.
Brakes	Bendix, duro-servo, 14 x 3 Hydraulically actuated
TAIL WHEEL GEAR	
Type	Full-swiveling, nonretractable
Type of strut	Air-oil
Make and part No.	Douglas, 5115222
Fluid required	Same as for main gear struts
Wheel	
Type	Bendix B-1 9:00 x 6
Tire	22 x 9:00 x 6 8-ply
Tire pressure	Must be determined by deflection as instructed in paragraph 4.*b*.(7)*(c)*, section IV.

ENGINES

Number required	Two
Designation	C-47, C-47A Pratt and Whitney R-1830-92 C-47B Pratt and Whitney R-1830-90C
Propeller reduction gear ratio	16:9
Oil	AN-O-8 grade 1120 (summer), 1100 (winter)
Fuel	AN-F-48 grade 100/130

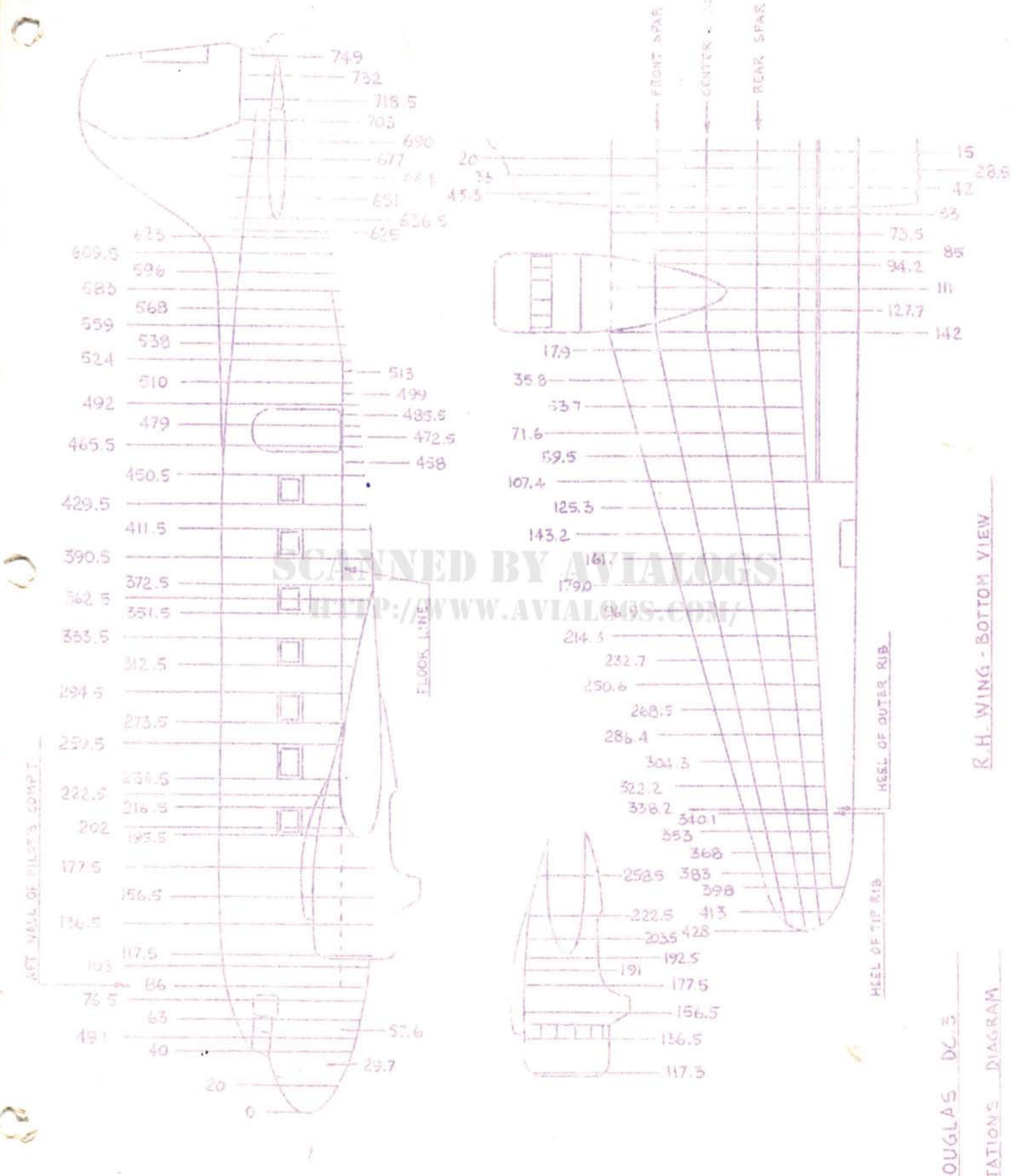
PROPELLERS

Type	3-bladed, hydromatic, quick feathering, constant-speed control
Manufacturer	Hamilton Standard
Hub No.	Hamilton 23E50
Blade No.	C-47. . .6353A-18 (narrow) C-47A. .6353A-18 (narrow) and 6477A-O (wide)
Diameter	11 ft 7 in.
Constant-speed control	
Number	4K11-GOJ (single-capacity governor used with narrow blades) 4G8-G15D, 4G8-G15G, 4G8-G23G, 4G8-G23G-1 (double-capacity governors used with wide blade propellers)
Blade angle setting	
6353A-18 (narrow blades)	18 degrees low, 88 degrees high
6477A-O (wide blades)	16 degrees low, 88 degrees high



749
732
718.37
703
690
677
664
651
636.625
623
625
609.62
596
583
568
559
538
520
513
506
499
492
485.5
479
472.5
465.5
458
450.5
429.5
411.5
390.5
372.5
363.5
362.5
351.5
333.5
312.5
294.5
273.5
258.5
234.5
222.5
216.5
202
203.5
195.5
192.5
191
177.5
156.5
136.5
117.375
103
86
76.5
63
57.625
49.125
40
29.75
20
0
63.9
LONG. #16
LONG. #17
STUB FRAMES
FLOOR LINE
REAR SPAR
CENTER SPAR
WING ATTACH. POINTS
FRONT SPAR
AFT WALL OF PILOT'S COMPT.
LONG. #9
THRUST LINE
LONG. #17
258.5
222.5
203.5
192.5
191
177.5
156.5
136.5
117.375
103
76.5
7.5
20
33
45.3125
FRONT SPAR
CENTER SPAR
REAR SPAR
5
15
28.5
42
58
73.5
85
94.25
111
127.75
142
17.9
35.8
53.7
71.6
89.5
107.4
125.3
143.2
161.1
179.0
196.9
214.8
232.7
250.6
268.5
286.4
304.3
322.2
338.2
340.1
HEEL OF TIP RIB
HEEL OF OUTER RIB
353
368
383
398
413
428
RIGHT HAND WING—BOTTOM VIEW

Figure 5—Stations Diagram


FRONT SPAR
CENTER SPAR
REAR SPAR
749
732
718.5
705
690
677
664
651
636.5
625
623
609.5
596
583
568
559
538
524
510
513
499
492
485.5
479
472.5
465.5
458
450.5
429.5
411.5
390.5
372.5
362.5
351.5
333.5
312.5
294.5
273.5
259.5
234.5
222.5
216.5
202
195.5
177.5
156.5
136.5
117.5
103
86
76.5
63
49.1
40
57.6
29.7
20
0
FLOOR LINE
AFT WALL OF PILOT'S COMPT.
20
33
45.5
15
28.5
42
53
73.5
85
94.2
111
127.7
142
17.9
35.8
53.7
71.6
89.5
107.4
125.3
143.2
161.1
179.0
196.9
214.3
232.7
250.6
268.5
286.4
304.3
322.2
338.2
340.1
353
368
383
398
413
428
HEEL OF OUTER RIB
HEEL OF TIP RIB
258.5
222.5
203.5
192.5
191
177.5
156.5
136.5
117.3

R.H. WING - BOTTOM VIEW

DOUGLAS DC-3

STATIONS DIAGRAM

TANK CAPACITIES

FUEL	
Main tanks	(2) 202 U.S. (168.3 Imp.) Gal
Auxiliary tanks	(2) 200 U.S. (167 Imp.) Gal
Long-range tanks (2 to 8 may be installed)	(8) 100 U.S. (83 Imp.) Gal
Total	(12) 1604 U.S. (1334.6 Imp.) Gal
OIL	
Nacelle tanks (one for each engine)	(2) 29 U.S. (24 Imp.) Gal
Total	58 U.S. (48 Imp.) Gal
Expansion space	2.9 U.S. (2.4 Imp.) Gal

SETTINGS AND RANGES OF MOVEMENT OF CONTROL SURFACES

Stabilizer	Fixed
Fin	Fixed
Ailerons	
"UP" travel	13 ± ⅛ in. (27 degrees)
"DOWN" travel	8 ± ½ in. (18 degrees)
Aileron droop	(1½ degrees)
Aileron trim tabs	
"UP" travel	2 ± ⅛ in. (12½ degrees)
"DOWN" travel	2 ± ⅛ in. (12½ degrees)
Flaps (total)	(45 degrees)
Elevators	
"UP" travel	12 ± ⅛ in. (30 degrees)
"DOWN" travel	8 ± ⅛ in. (20 degrees)
Elevator trim tabs	
"UP" travel	1⅝ ± ⅛ in. (12 degrees)
"DOWN" travel	1⅝ ± ⅛ in. (12 degrees)
Rudder	
"RIGHT" travel	26½ ± ¼ in. (29½ degrees ± 1 degree)
"LEFT" travel	26½ ± ¼ in. (29½ degrees ± 1 degree)
Rudder trim tabs	
"RIGHT" travel	2¾ ± ⅛ in. (12 degrees)
"LEFT" travel	2¾ ± ⅛ in. (12 degrees)

SECTION II

SHIPMENT AND ERECTION PROCEDURE

1. GENERAL.

The information included in this section is provided to cover disassembly, shipping, and erection or storage of the major components of the airplane. Refer to the list of specifications following for applicable information on the handling of these units. No specific information is given concerning shipment of the fuselage, since such shipment is subject to so many variable conditions. Complete information on removal or installation of the units is given in section IV. (See table I following for paragraph references.) Weights given in the table are for the unit alone and do not include crating or packaging materials. Complete information on ground handling and ground operation of the airplane is included in section III. In accomplishing this work keep in mind the following precautions:

a. When parts are removed, mark them with the airplane serial number and the left- or right-hand part number.

b. When possible replace bolts in their original bolt holes.

c. Place screws and similar small parts in a bag and secure to the unit from which they were removed.

d. To assure correct reassembly, apply a thin strip of tape to the male fittings of all actuating rods or turnbuckles at the point where the male fitting joins the female fitting.

e. All parts must be thoroughly cleaned and dried prior to application of preservation or dehydration method according to applicable specifications.

f. Apply any binding twine or tape loose enough to prevent the wrapping material from wearing through the protective coating.

g. Always use freshly activated dehydrating agent in the dessicater units.

Refer to the list below for applicable specifications for the unit being handled.

APPLICABLE SPECIFICATIONS

AN-C-52 Exterior Surface Corrosion-Preventive Compound

AN-C-61 Ceramic Spark Plug Cleaning Compound

AN-C-67 Moisture Impervious Containers

AN-C-80 Corrosion-Prevention—Method of Handling Aircraft Engines

AN-D-6 Dehydrating Agent (Activated)

AN-E-1 Moisture Impervious Envelopes

AN-O-S-366 Silica Gel Dehydrating Agent

AN-P-12 Greaseproof Wrapping Paper

AN-P-13 Preservation and Packaging of Metal Parts and Equipment

AN-P-30 Aircraft Propeller Packaging and Packing (for Domestic and Overseas Shipment)

AN-P-47 Dehydrator Plugs

AN-T-12 Adhesive Tape

AN-VV-C-576 Aircraft Engine Corrosion-Preventive Compound

AN-VV-N-96 Petroleum Aromatic Naphtha

AAF 18-G Waterproofing Compounds for Fabrics (bulletin)

AN-138 Aircraft Engine Corrosion-Preventive Compound (bulletin)

AN-155 Exterior Surface Corrosion-Preventive Compound (bulletin)

AN-162 Moisture Impervious Containers (bulletin)

Army 100-14 General Specification for Packaging and Packing for Overseas Shipment

Army 23-31 Boxes for Aircraft Engines

Army 23-33 Boxes for Shipping Storage Batteries

Army 23-36 Boxes for Shipping Oxygen Supply Tanks

Army 23-78 Packing and Boxing Aircraft (for Overseas Shipment)

Army 3-138 Waterproofing Compound (for Fabrics) (Navy, Bu. Ships 52-C-26 (INT))

AAF 20015 Aircraft Cleaning Compound

AAF 3595 Fuel Tank Slushing Compound

AAF 3596 Fuel Tank Sealing Compound

AAF 3597 Oil Tank Sealing Compound

Army 98-20007 Cleaning of Aircraft Metal Surfaces Prior to Application of Initial Protective Coating Navy, Aero. SR-15)

Army 98-24100 Doping Aircraft Fabric Surfaces (Navy, Aero. SR-70)

Federal P-P-126 Waterproof Garnet Paper

Federal P-S-661 Dry Cleaning Solvent

Federal UU-P-271 Waterproofed Kraft Wrapping Paper

AAF 28480 Preparation for Storage of Aircraft Engine Accessories

AAF 40755 Shipment Marking (Beneficiary Governments)

Army 94-40672 Packaging of Lightweight Aircraft Accessories

Army 94-40645 Shipment Marking (Domestic and Export)

Note

The following information is general and is not intended to cover completely the shipment, crating, or storage of these parts. Reference should always be made to applicable specifications.

2. WING, EMPENNAGE, AND CONTROL SURFACES.

If possible, tape all cables to the structure. Otherwise remove cables, bell cranks, fittings, etc., and dip, spray, or brush with corrosion-preventive compound, Specification No. AN-C-52. Inspect all surfaces and clean bare metal with dry cleaning solvent, Federal Specification No. P-S-661, or naphtha, Army Specification No. 4-1040. Brush the bare metal surfaces with compound conforming to Specification No. AN-C-52, type I, at room temperature and drain until dry.

WARNING

Do not permit the corrosion-preventive compound to come in contact with fabric surfaces or shielded bearings. This may be prevented by masking such areas with tape and greaseproof paper. After being unpacked, the part may be cleaned as instructed above.

3. LANDING GEAR.

a. MAIN GEAR.—The main gear is usually disassembled into the following four units for shipment: wheel and brake assembly, shock absorber strut assembly, upper truss assembly, and rear brace strut assembly. The first two assemblies should be shipped in dehydrated packages. The later two may be cleaned with dry cleaning solvent, Federal Specification No. P-S-661, and covered with corrosion-preventive compound, Specification No. AN-C-52. Cap all hydraulic lines to keep out foreign material and tape the ends of all electrical wires. Deflate the shock struts as instructed in section IV, paragraph 4, before removing the gear from the airplane.

b. TAIL GEAR.—Follow instructions given in paragraph *3.a.,* preceding, for handling the tail wheel and gear.

4. ENGINE.

The engine section may be shipped in several different assemblies. First, the engine assembly (minus accessories) may be shipped or stored as instructed in Specification No. AN-C-80. The antidrag ring, including cowl flaps, engine mount, and various power plant accessories, may be shipped separately or assembled with the engine accessories cowling. Refer to the list included in paragraph 1, preceding, for applicable specifications for handling spark plugs, air screens and filters, batteries, and other accessory parts.

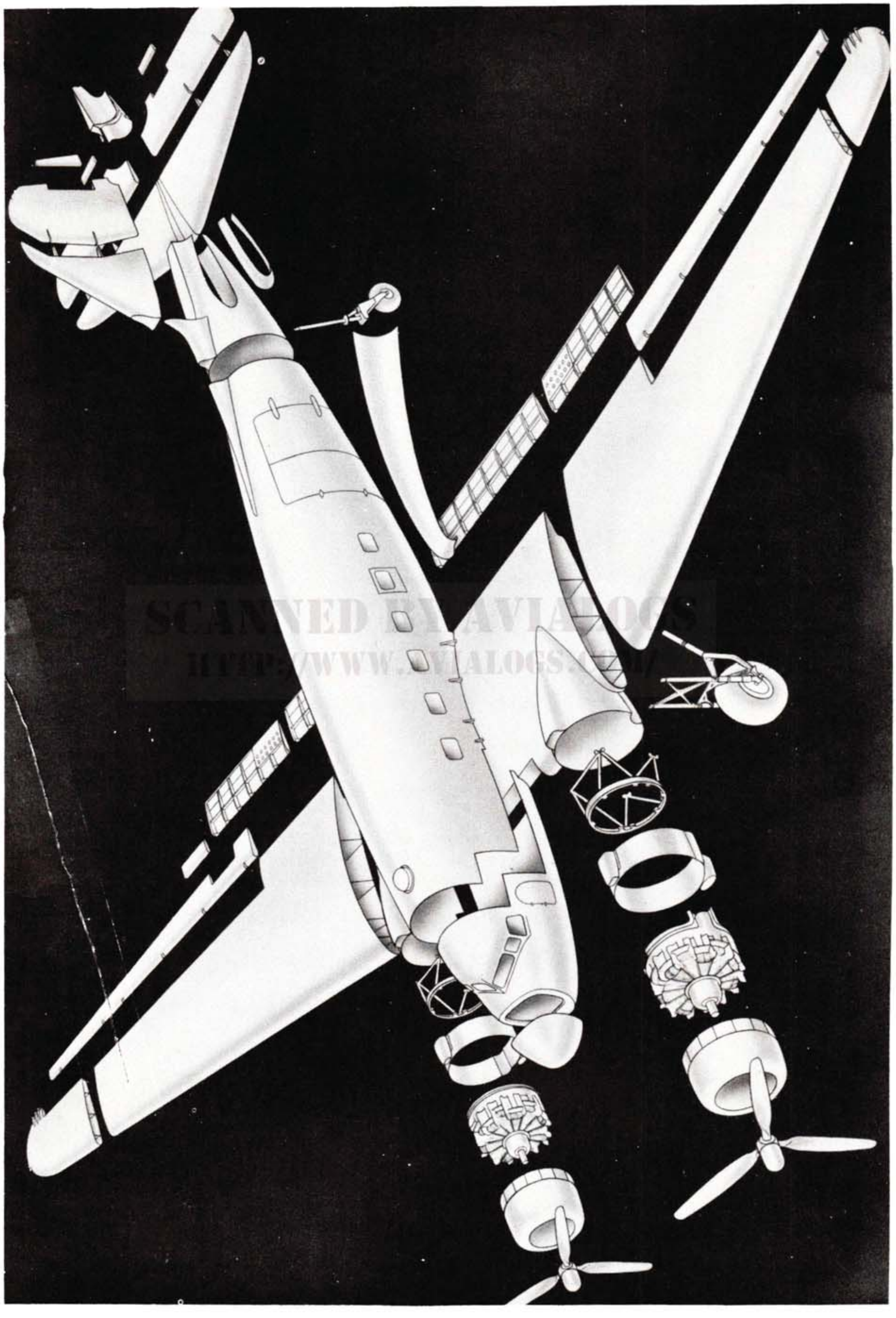


Figure 6—Major Components of Airplane (Exploded View)

5. PROPELLERS.

Propellers are to be shipped as a complete assembly, as instructed in Specification No. AN-P-30. If they are to be transported on the under side of the fuselage, follow the instructions given in section V, paragraph 1.*c*. In this case the propeller hub must be removed and carried inside the airplane and the blades must be fully feathered. The trailing antenna is not to be used when a three-bladed propeller is being carried in the forward position.

6. RUBBER AND SYNTHETIC RUBBER PARTS.

Do not permit any corrosion-preventive compound to come in contact with these parts. Protect them with a covering of greaseproof paper. Remove rubber or synthetic rubber sealing strips from parts to be shipped and wrap them in kraft paper.

7. GLASS AND PLEXIGLAS.

Cover glass or Plexiglas with three layers of kraft paper. Secure the paper to the glass with tape, Specification No. AN-P-12, but under no condition permit the tape to touch the glass or Plexiglas surface.

TABLE I—MAJOR COMPONENTS

Part Name	*Part No.*	*Removal Reference Section IV*	*Weight each Lb*	*DIMENSIONS*			*Cleaning Spec*	*Preservation Spec and Method*	*Packing Spec*
				Width	*Length*	*Depth*			
AILERONS	5115202 and 1	Paragraph 12.*b*.(1)*(b)1*.	57	2 ft. 10 in.	24 ft. 1 in.	9 in.	Fed. P-S-661 (bare metal only)	AN-C-52, type I	Army 100-14 AN-P-13 method 1
AILERON TAB	5115203	Paragraph 12.*b*.(1)*(b)2*.	3	10 in.	2 ft. 11 in.	2 in.			Army 100-14
RUDDER	5115212	Paragraph 12.*b*.(3)*(b)1*.	63	5 ft. 5 in.	9 ft. 2 in.	11 in.	Fed. P-S-661 (bare metal only)	AN-C-52, type I	Army 100-14
RUDDER TAB	5115213	Paragraph 12.*b*.(3)*(b)2*.	4	1 ft. 1 in.	3 ft. 9 in.	3 in.			Army 100-14
ELEVATORS	5115210	Paragraph 12.*b*.(2)*(b)1*.	49	3 ft. 10 in.	11 ft. 10 in.	8 in.	Fed. P-S-661 (bare metal only)	AN-C-52, type I	Army 100-14
ELEVATOR TAB	5115211	Paragraph 12.*b*.(2)*(b)2*.	3	9 in.	2 ft. 10 in.	2 in.			Army 100-14
VERTICAL STABILIZER	5115208	Paragraph 2.*b*.(2)	87	7 ft. 3 in.	9 ft. 4 in.	1 ft. 1 in.	Fed. P-S-661 (bare metal only)	AN-C-52, type I	Army 100-14
HORIZONTAL STABILIZER	5115209	Paragraph 2.*b*.(1)	124	13 ft. 5 in.	7 ft. 10 in.	1 ft. 4 in.	Fed. P-S-661 (bare metal only)	AN-C-52, type I	Army 100-14
WING FLAPS	5115204-1 outer wing (L & R)	Paragraph 12.*b*.(4)*(b)*	19	2 ft.	8 ft. 6 in.	2 in.	Fed. P-S-661 (bare metal only)	AN-C-52, type I	Army 100-14
	(5115205 center wing)		19	2 ft.	11 ft. 6 in.	2 in.			
OUTER WING PANEL	5110578-1	Paragraph 1.*b*.(1)	918	15 ft. 10 in.	35 ft. 1 in.	2 in.	Fed. P-S-661 (bare metal only)	AN-C-52, type I	Army 100-14
*CENTER WING SECTION	4110505	Paragraph 1.*b*.(3)	Approx. 3000	15 ft. 10 in.	23 ft. 8 in.	5 ft. 4 in.	Fed. P-S-661 (bare metal only)	AN-C-52, type I	Army 100-14

TABLE I—MAJOR COMPONENTS (Con't)

Part Name	*Part No.*	*Removal Reference Section IV*	*Weight each Lb*	*DIMENSIONS*			*Cleaning Spec*	*Preservation Spec and Method*	*Packing Spec*
				Width	*Length*	*Depth*			
TAIL CONE	5110214	Paragraph 3.*b.*(2)	21	3 ft.	3 ft. 10 in.	3 ft. 5 in.	Fed. P-S-661	AN-C-52, type I	Army 100-14
FUSELAGE AFT SECTION	5110532	Paragraph 3.*b.*(1)		5 ft. 3 in.	6 ft. 5 in.	10 ft. 5 in.	Fed. P-S-661	AN-C-52, type I	Army 100-14
MAIN CARGO DOOR	5124460 5142704		83	aft 4 ft. 9 in. fwd 3 ft. 5 in.	5 ft. 10 in. 6 ft. 3 in.	1 ft. 2 in. 1 ft. 2 in.	Fed. P-S-661	AN-C-52, type I	Army 100-14
MAIN LANDING GEAR	5110568 5203619	Paragraph 4.*b.*(1)*(b)*	620						
REAR BRACE STRUT	5112599	Paragraph 4.*b.*(1)*(b)*	63	2 ft. 8 in.	5 ft. 10 in.	4 in.	Fed. P-S-661	AN-C-52, type I	Army 100-14
UPPER TRUSS ASSEMBLY	5110569 5141775	Paragraph 4.*b.*(1)*(b)*	84	3 ft. 2 in.	4 ft. 3 in.	8 in.	Fed. P-S-661	AN-C-52, type I	Army 100-14
SHOCK STRUT TRUSS ASSEMBLY	5110414	Paragraph 4.*b.*(1)*(b)*	31	9 in.	1 ft. 11 in.	2 in.	Fed. P-S-661	AN-C-52, type I	Army 100-14
†WHEEL ASSEMBLY	5116415	Paragraph 4. *b.*(1)*(b)*	321	46 in.	Diameter	38 in.	Fed. P-S-661	AN-P-13, Domestic-method I Overseas-method II	Army 100-14
SHOCK ABSORBER STRUT ASSEMBLY	Bendix 65900	Paragraph 4.*b.*(4)*(b)*	113	3 ft.	3 ft. 6 in.	1 in.	Fed. P-S-661	AN-P-13, method II	Army 100-14
TAIL WHEEL INST.	5115220	Paragraph 4.*c.*(2)*(a)*	181	2 ft. 4 in.	8 ft.	1 ft. 5 in.	Fed. P-S-661	AN-P-13, method II	Army 100-14
‡ENGINE	5110571	Paragraph 6.*b.*(1)*(a)*	1420	4 ft. 6 in.	Diameter	4 ft. 6 in.	AN-C-80 AAF 28480	AN-C-80, AN-VV-C-576	AN-C-80 Army 100-14
ANTIDRAG RING (with cowl flaps)	5113759 5141800	Paragraph 5.*e.*(2)		4 ft. 8 in.	Diameter	3 ft. 3 in.	AN-C-80	AN-C-80	AN-C-80 Army 100-14
ENGINE MOUNT	5110599 5141024	Paragraph 5.*b.*	72 47	3 ft. 5 in.	3 ft. 2 in.	3 ft. 6 in.	Fed. P-S-661	AN-C-52, type I	AN-C-80 Army 100-14
MAIN FUEL TANK	5110508-1	Paragraph 10.*b.*(2)*(a)*	69	2 ft. 8 in.	6 ft. 5 in.	1 ft. 11 in.	AAF 3595 Fed. P-S-661	AN-C-52, type I AAF 3596, 3597	Army 100-14
AUXILIARY FUEL TANK	5110509-1	Paragraph 10.*b.*(2)*(b)*	72	2 ft. 8 in.	7 ft. 2 in.	1 ft. 9 in.	AAF 3595 Fed. P-S-661	AN-C-52, type I AAF 3596, 3597	Army 100-14

TABLE I MAJOR COMPONENTS (Con't)

Part Name	*Part No.*	*Removal Reference Section IV*	*Weight each Lb*	*DIMENSIONS*			*Cleaning Spec*	*Preservation Spec and Method*	*Packing Spec*
				Width	*Length*	*Depth*			
§ LONG-RANGE FUEL TANK	5140523	Paragraph 10. *k.*	210	Diameter 2 ft. 3 in.	5 ft. 2 in.		Army 3595 Fed. P-S-661	AN-C-52, type I Army 3596, 3597	Army 100-14
NACELLE OIL TANK	5110511-2 and -4.	Paragraph 9. *d.* (2)	30	3 ft. 6 in.	2 ft. 2 in.	1 ft. 5 in.	Army 3595 Fed. P-S-661	AN-C-52, type I Army 3596, 3597	Army 100-14
PROPELLER ASSEMBLY	5110566	Paragraph 7.	883	11 ft. 7 in.	Diameter	1 ft. 6 in.	AN-P-30	AN-P-30	AN-P-30

* Includes all fuel and oil tanks and similar equipment.
† Includes wheels, brakes, tires, and tubes inflated
‡ Engine basic—with no accessories installed.
§ Complete installation for 2 long-range fuel tanks.

SECTION III

HANDLING AND GENERAL MAINTENANCE INSTRUCTIONS

1. ACCESS AND INSPECTION PROVISIONS.

This airplane is equipped with 164 inspection doors and cover plates. Their purpose is to provide access to various covered parts of the airplane which require inspection, adjustment, repair, replacement, or servicing. Their locations are indicated in figures 7, 8, 9, and 10 which show, respectively, the bottom, top, left, and right surfaces of the airplane.

2. GROUND HANDLING.

Provisions are made for hoisting, jacking, leveling, parking, mooring, towing, and servicing the airplane, as outlined in the following paragraphs.

a. HOISTING PROVISIONS.—Provisions are made for hoisting the complete airplane, the fuselage, the outer wing panel, the horizontal stabilizer, the vertical stabilizer, the rudder, the engine assemblies, and the propellers. Various types of slings are required in hoisting. They may be obtained by requisition through channels from supply depots or may be constructed by activities which have adequate shop facilities and materials.

CAUTION

> In every case, the capacity and suspension of overhead hoisting equipment must be carefully checked before it is used, and specific authority for its use must be obtained from the squadron engineering officer.

KEY TO FIGURE 7

1. Aileron Hinge Cover
2. Aileron Turnbuckle Access
3. Aileron Cable and Pulley Access
4. Fuel and Instrument Lines Access
5. Fuel Tank Covers
6. Fuel Line Access
7. Hydraulic Lines Inspection

KEY TO FIGURE 7 (Cont'd)

8. Bell Crank Inspection
9. Flap Strut Access
10. Formation Lights Access
11. Elevator Tab Drum Access
12. Brace Strut Bolt Access
13. Bell Crank Access
14. Fuel Lines Access
15. Selector Valve Access (2)
16. Engine Controls Access
17. Rear Spar Access
18. Aileron Tab Drum Access
19. Wing Inspection
20. Light Access
21. Electrical Junction Box Access
22. Outer Aileron Bell Crank Access
23. Wing Inspection
24. Aileron Inner Bell Crank Access
25. Aileron Cable Inspection
26. Brake Line Access
27. Outer Wing Access
28. Nacelle Inspection
29. Starter Cable Release Access Door
30. Wing Nose Section Access
31. Wobble Pump Control Access
32. Outside Battery Receptacle
33. Battery Access
34. Servo Cable Access
35. Control Cable Access
36. Control Cable Inspection
37. Pedestal and Control Column Access
38. Control Cable Access
39. Fuselage Tunnel Covers
40. Turnbuckle Access
41. De-Icer, Distributor Valve Inspection
42. Hydraulic and De-Icer Lines Access
43. Fuel and Instrument Lines Access
44. Oil Cooler Drain Plug Access
45. (Starter Release) Ground Heat Duct
46. Landing-Gear Attach Bolt Access
47. Brake Line Access
48. De-Icer Lines Access
49. De-Icer Drain Cock

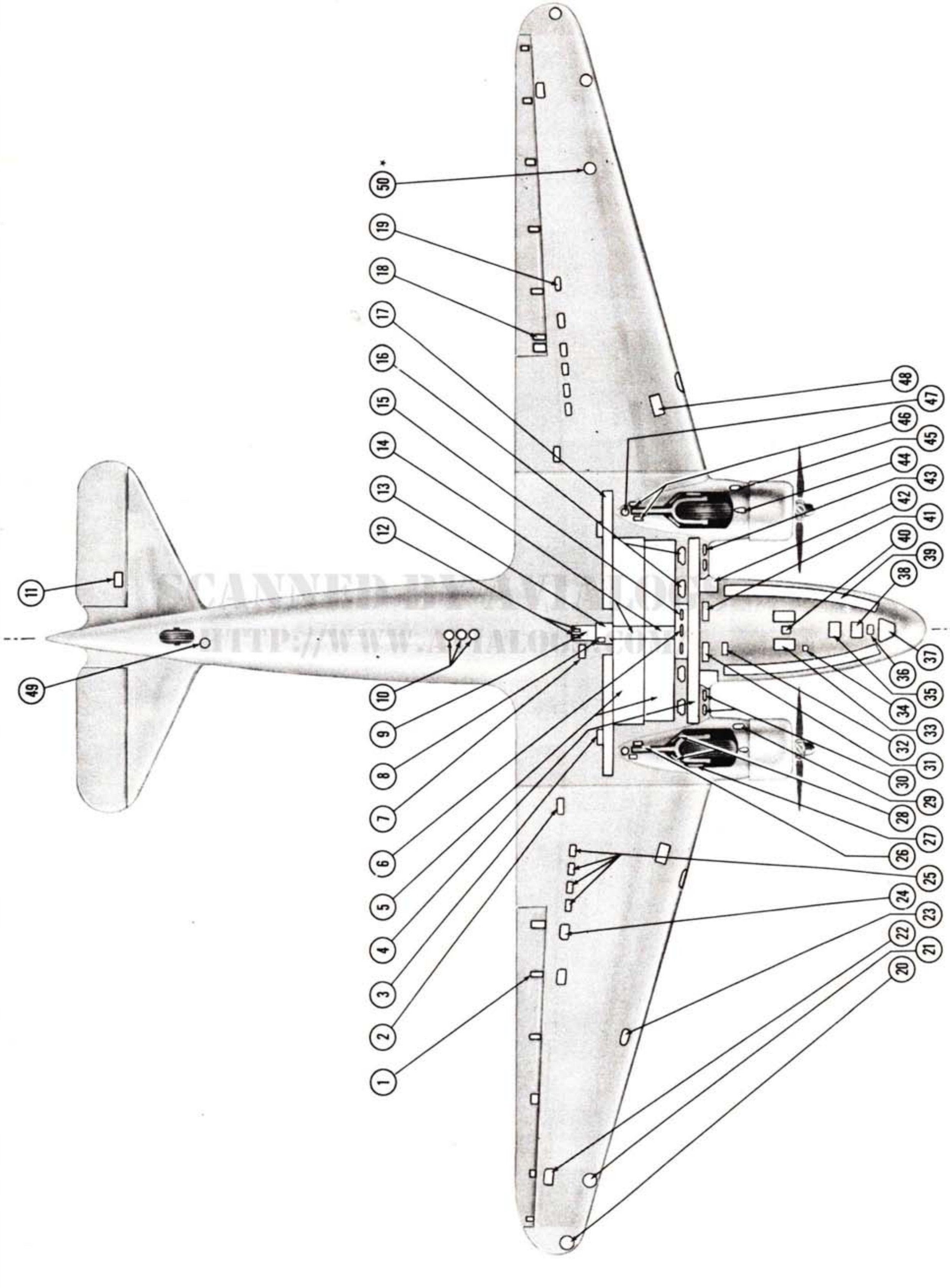
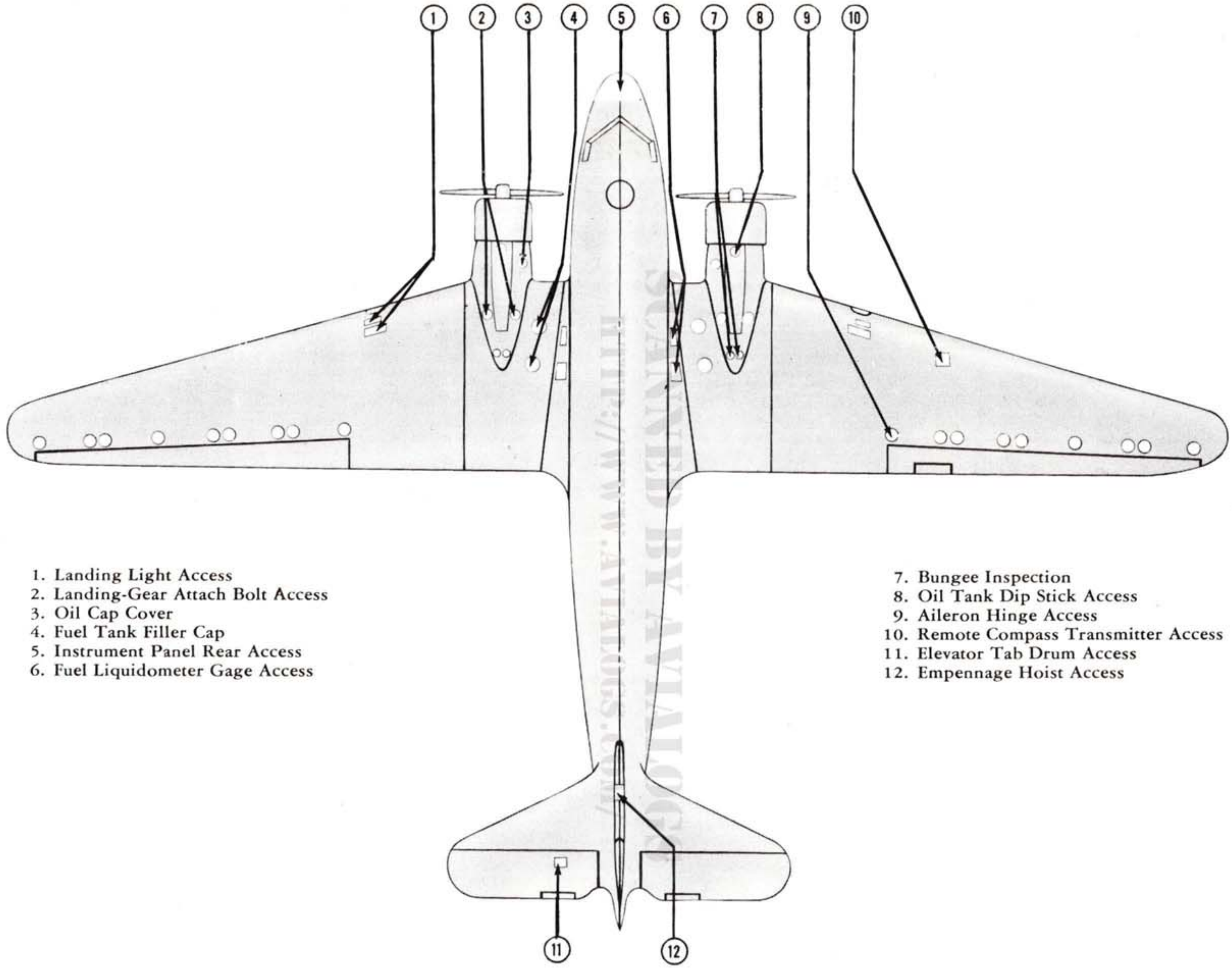

15,094
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50*

Figure 7—Inspection Doors and Cover Plates (Bottom)

SCANNED BY AVIALOGS HTTP://WWW.AVIALOGS.COM



1. Landing Light Access
2. Landing-Gear Attach Bolt Access
3. Oil Cap Cover
4. Fuel Tank Filler Cap
5. Instrument Panel Rear Access
6. Fuel Liquidometer Gage Access

7. Bungee Inspection
8. Oil Tank Dip Stick Access
9. Aileron Hinge Access
10. Remote Compass Transmitter Access
11. Elevator Tab Drum Access
12. Empennage Hoist Access

Figure 8—Inspection Doors and Cover Plates (Top)

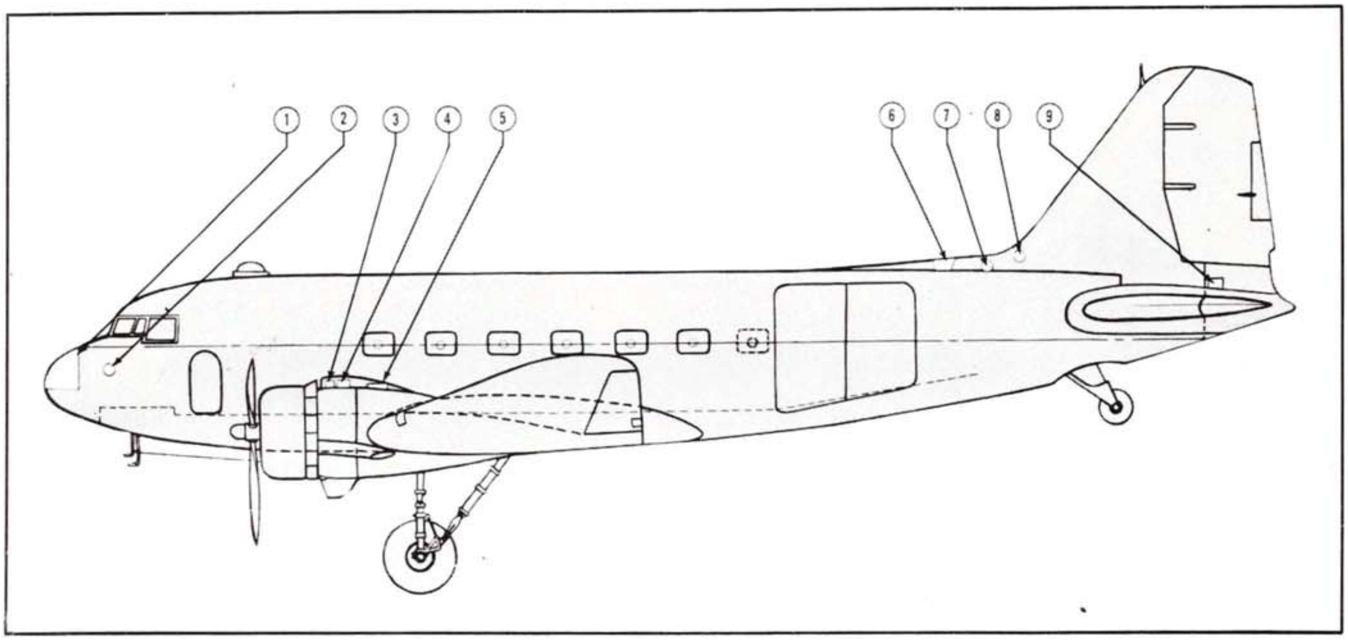


Figure 9—Inspection Doors and Cover Plates—Left Side

1. Rear Instrument Panel Access
2. Antenna Installation Access
3. Ram Door (Actuating Cylinder) Access (Also Scoop Removal 4 Places)
4. Ram Door Linkage (Also Scoop Removal 4 Places)
5. Removal of Rear Half of Scoop (4 Places)
6. Tail Surface Hoisting Access
7. Vertical Stabilizer De-Icer Access
8. Vertical Stabilizer De-Icer Access
9. Cone Junction Tube Access

6 2
7
9
8 0

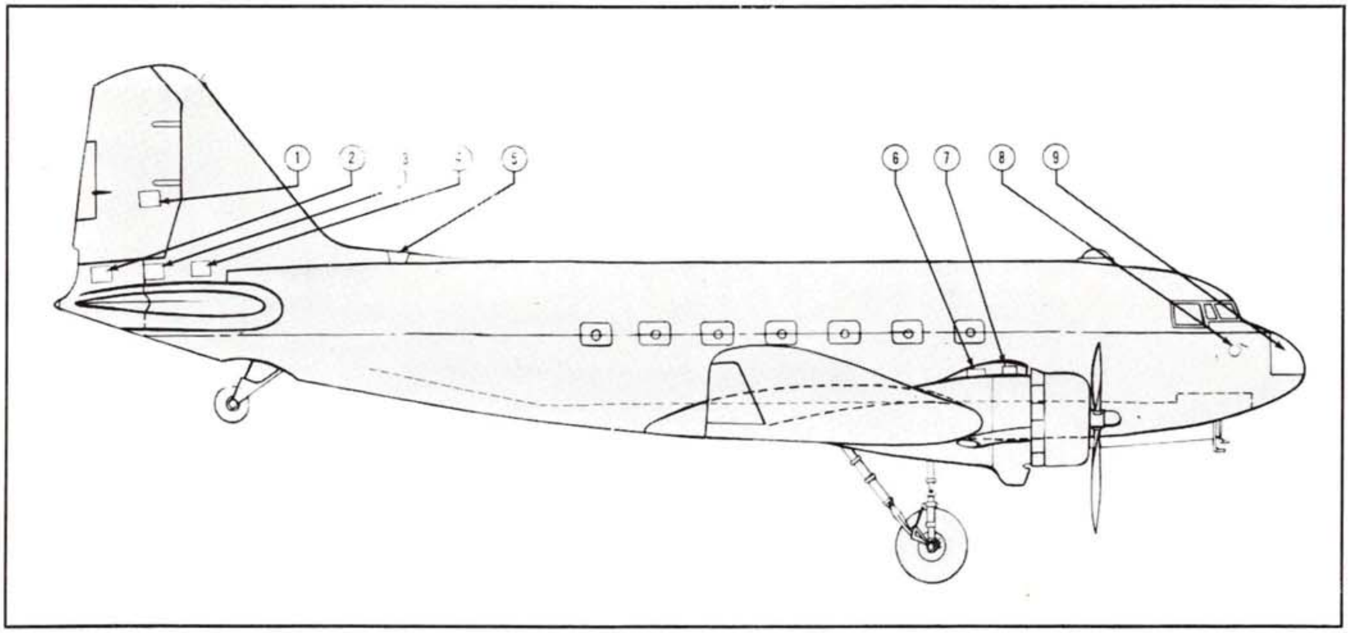


Figure 10—Inspection Doors and Cover Plates—Right Side

1. Rudder Tab Drum Access
2. Elevator Torque Tube Access
3. Rudder Torque Tube Access
4. Electrical Junction Box Access
5. Tail Surface Hoisting Access
6. Scoop Removal Access (4 Places)
7. Ram Actuating Cylinder and Scoop Removal
8. Antenna Installation Access
9. Rear Instrument Panel Access Hood

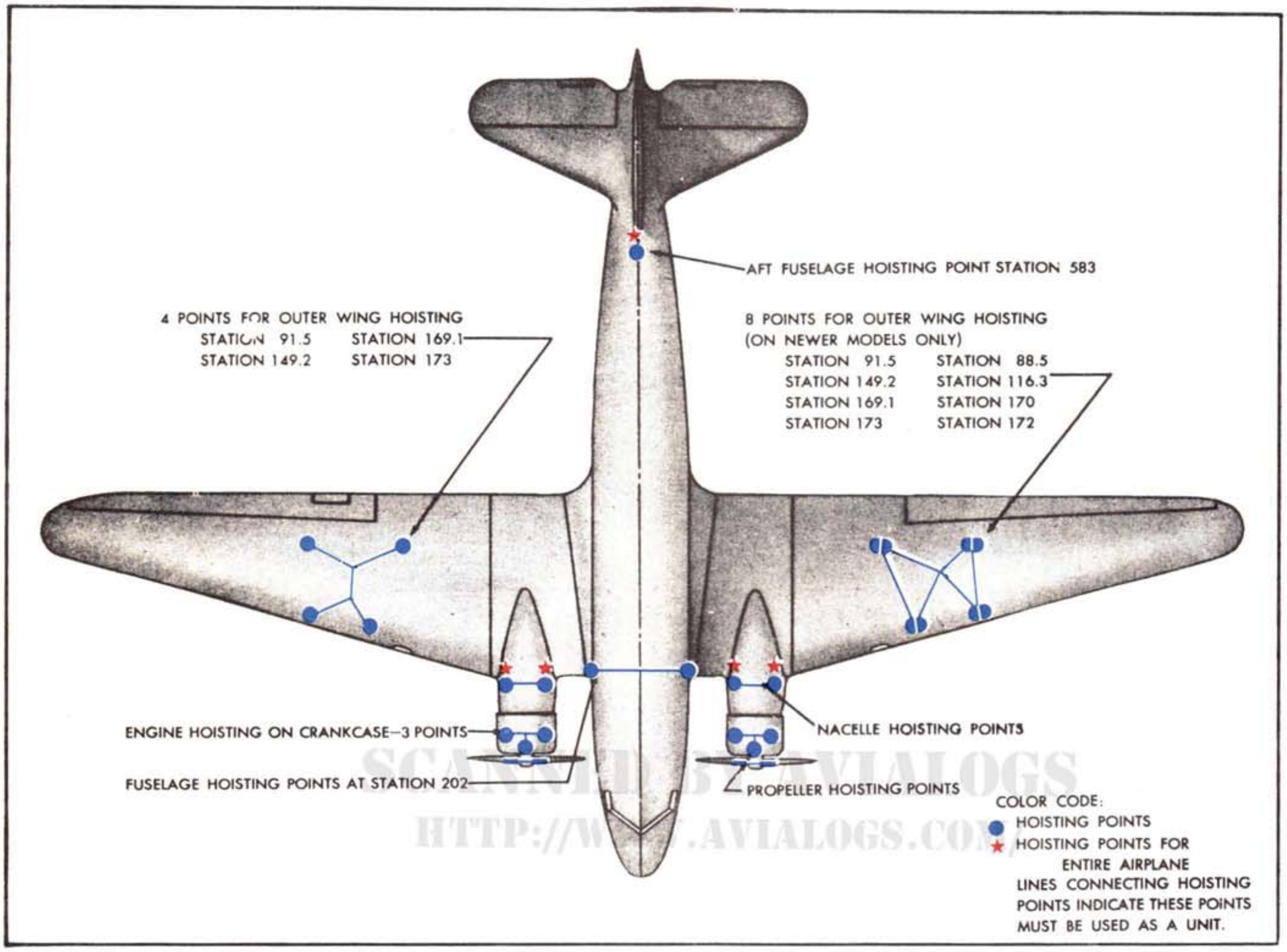

AFT FUSELAGE HOISTING POINT STATION 583
4 POINTS FOR OUTER WING HOISTING
STATION 91.5 STATION 169.1
STATION 149.2 STATION 173
8 POINTS FOR OUTER WING HOISTING
(ON NEWER MODELS ONLY)
STATION 91.5 STATION 88.5
STATION 149.2 STATION 116.3
STATION 169.1 STATION 170
STATION 173 STATION 172
ENGINE HOISTING ON CRANKCASE—3 POINTS
NACELLE HOISTING POINTS
FUSELAGE HOISTING POINTS AT STATION 202
PROPELLER HOISTING POINTS
COLOR CODE:
● HOISTING POINTS
★ HOISTING POINTS FOR ENTIRE AIRPLANE
LINES CONNECTING HOISTING POINTS INDICATE THESE POINTS MUST BE USED AS A UNIT.

Figure 11—Hoisting Points

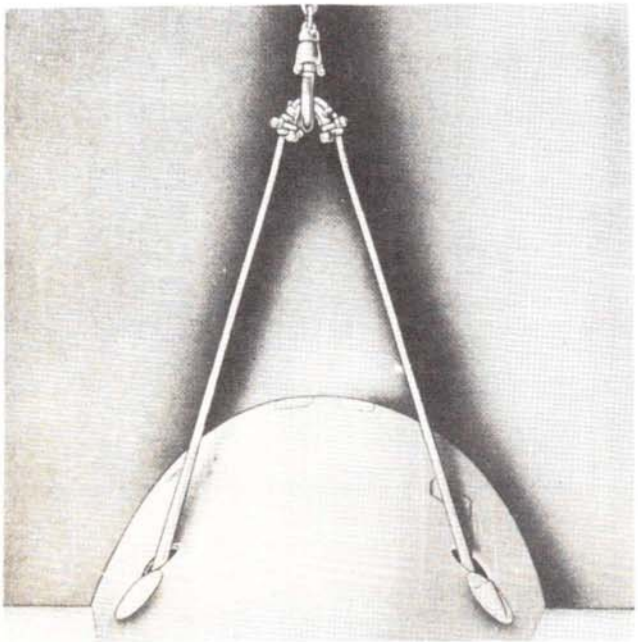


Figure 12—Two-Cable Nacelle Sling in Use

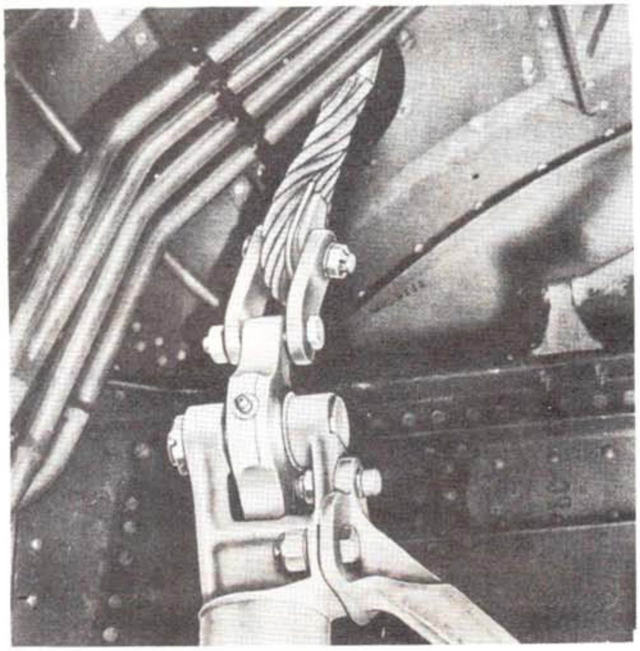


Figure 13—Nacelle Fitting With Sling Cable Attached

(1) HOISTING COMPLETE AIRPLANE.—Five permanently installed fittings are provided to lift the complete airplane by three separate hoists. (See figure 11.) Two hoists, one attached to a sling at either nacelle, lift the forward section, while a single hoist lifts the tail section. Each nacelle hoist is attached to a two-cable sling, as shown in figure 12. Inside the nacelle are two fittings to which the cables are fastened. The fittings are bolted to the top of each main landing-gear strut, which in turn is secured to the front spar of the center wing section. Figure 13 shows a nacelle fitting with a sling cable attached. Wing stands (figure 37) are often used with the hoists. (For other wing shoring methods, refer to *b.*(1)*(d)*, this paragraph.) The tail hoist is hooked to a permanently installed cable which is bolted to the fuselage structure at station 583, located in the fairing forward of the vertical stabilizer. Figure 14 shows the tail hoist hooked into this fitting.

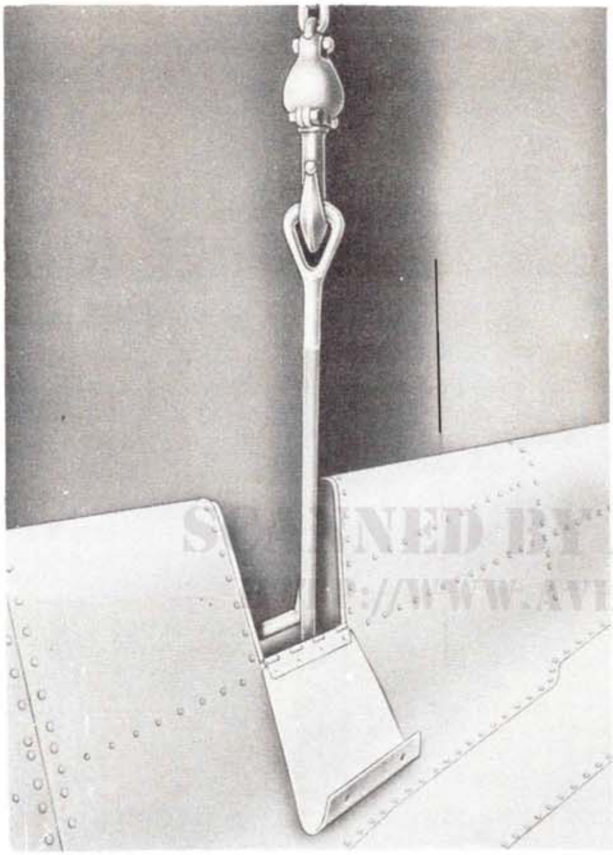


Figure 14—Tail Hoist Hooked to Permanent Fitting

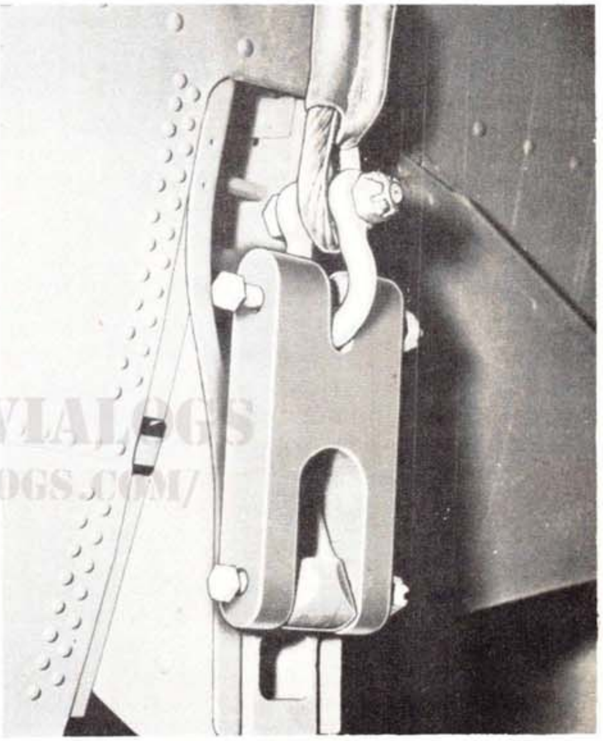


Figure 16—Sling Attached to Fuselage Fitting

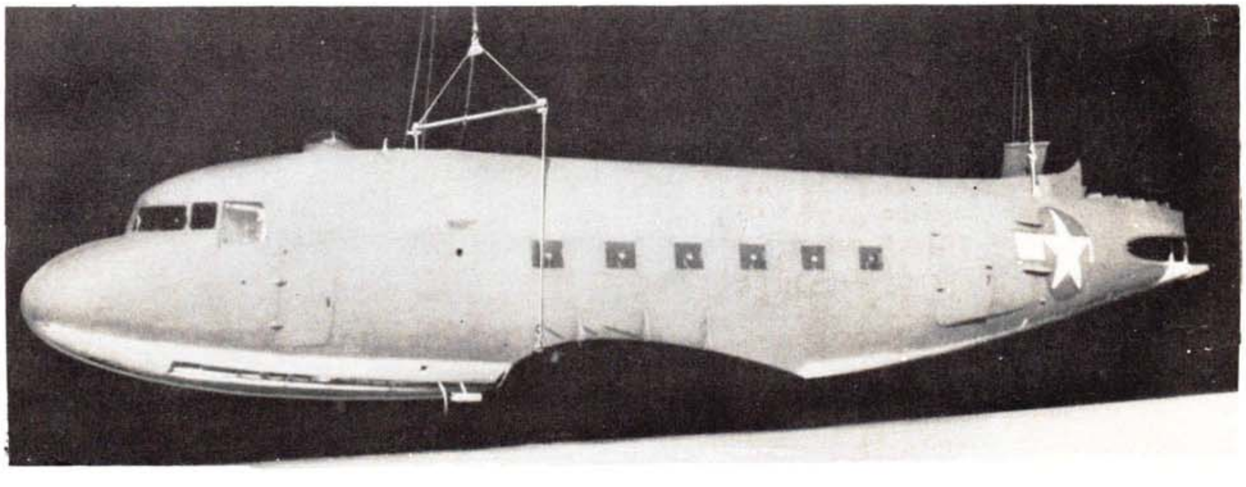


Figure 15—Hoisting the Fuselage

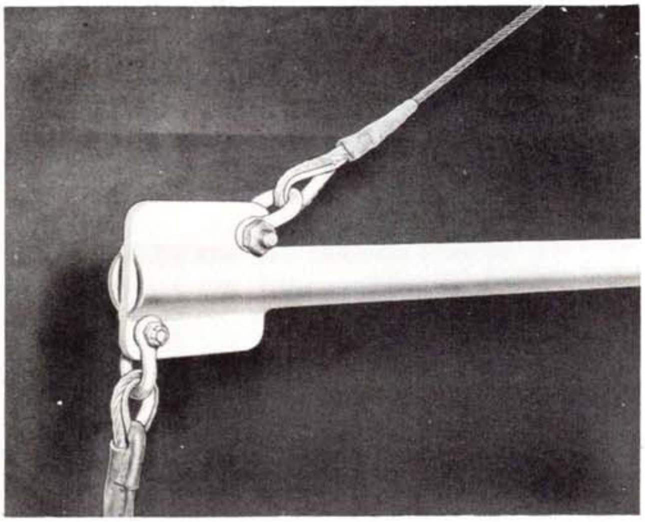


Figure 17—Spreader Attachments of Fuselage Sling

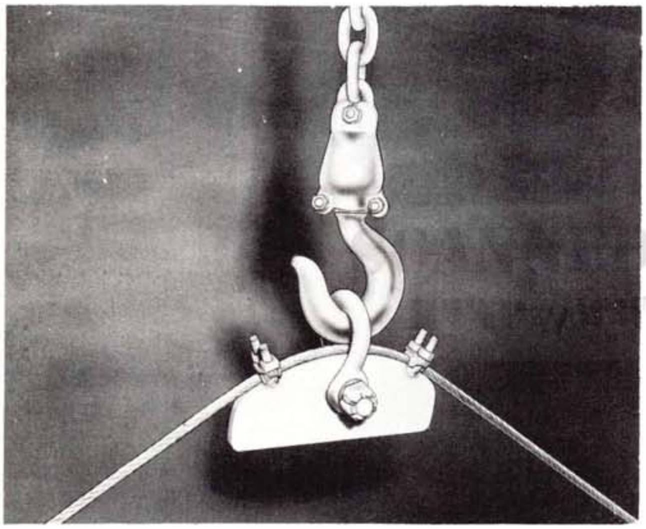


Figure 18—Inverted "V" of Fuselage Sling

As shown in figure 11, this same fitting is used when only the fuselage is hoisted. A tail stand, often useful in the hoisting procedure, is shown in figure 41. (Refer to paragraph 2.*b.*(2)*(a),* this section.) Access to the five fittings which are used with these three hoists is gained by removing cover plates (figure 7). Two of these plates are located near the top of each nacelle, and the third is located on top of the fuselage forward of the vertical stabilizer.

CAUTION

> In every case, the capacity and suspension of overhead hoisting equipment must be carefully checked before it is used, and specific authority for its use must be obtained from the station engineering officer.

(2) HOISTING FUSELAGE.—Two hoists must be used to lift the fuselage, as shown in figure 15. Refer to figure 11 to determine the location of these hoisting points. The forward hoist is hooked to a two-cable sling which is attached by clevises and bolts to permanent shackles on either side of the fuselage at station 202. This station is located forward of the auxiliary spar of the center wing section. The aft hoist is hooked to a permanently installed cable at station 583, which is forward of the vertical stabilizer, as shown in figure 14. This location is also indicated in figure 11. The same fitting is used in hoisting the aft section of the fuselage as is used in hoisting the tail section of the complete airplane. (See paragraph 2.*a.*(1), this section.) A tail stand which can be used for supporting the tail of this airplane, is shown in figure 41. (See paragraph 2.*b.*(2)*(a),* this section.) Before attempting to hoist the fuselage, remove all cargo, furnishings, and equipment from the interior in order to prevent buckling of the fuselage sides.

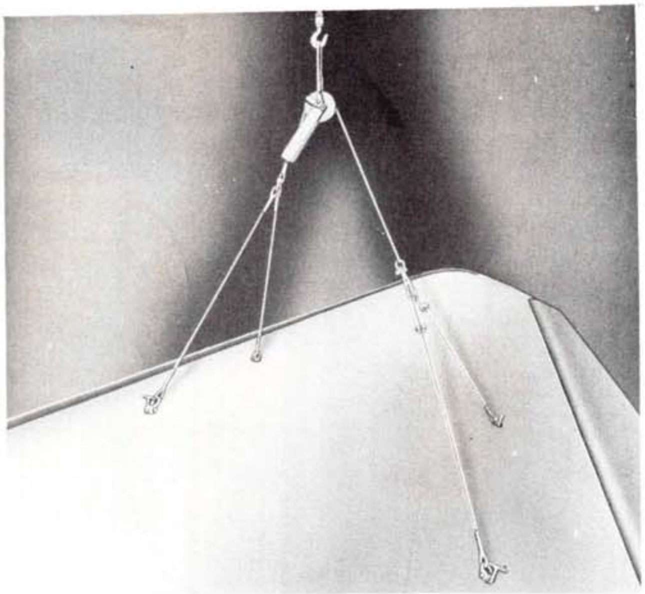


Figure 19—Four-Cable Outer Wing Sling in Use

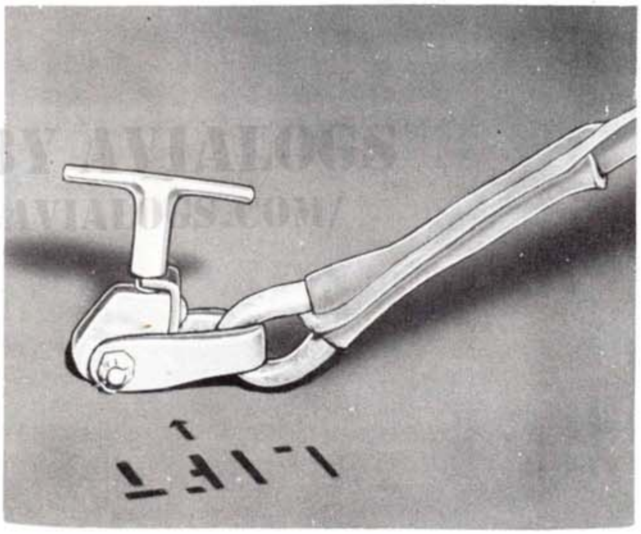


Figure 20—Sling Cable Attached to Outer Wing Panel

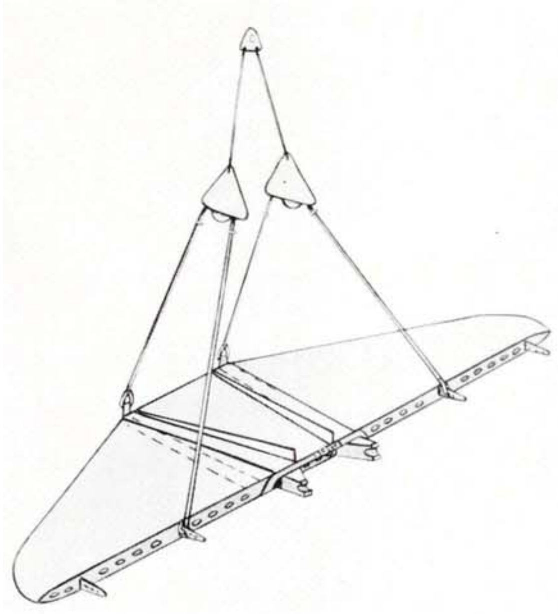


Figure 21—Hoisting Horizontal Stabilizer

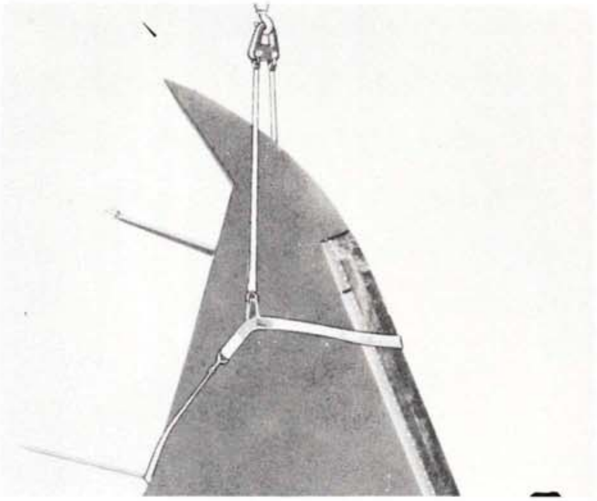


Figure 22—Hoisting Vertical Stabilizer

CAUTION

In every case, the capacity and suspension of overhead hoisting equipment must be carefully checked before it is used, and specific authority for its use must be obtained from the station engineering officer.

(3) HOISTING OUTER WING PANELS.—Two types of slings are provided to hoist an outer wing panel. The type of sling to be used depends on whether the panel is equipped with four sling fittings, as on older airplanes, or with eight sling fittings, as on newer airplanes. Figure 19 shows a four-cable sling (K10101) in operation. The four points of attachment (figure 11) are plugged with flathead screws when the sling is not installed. These screws are replaced by T-screws attached to the ends of the four sling cables when preparations are made for hoisting. Figure 14 shows one of these cables attached to the panel. Screws must be tightened snugly into the panel to prevent their bending and breaking. Construction details of the outer wing panel sling with four fittings are given in figure 105. The sling equipped with eight fittings also lifts by four cables, and is similarly installed with screws. It distributes the stresses more evenly over the wing surface during hoisting than the older type sling.

WARNING

When hoisting outer wing panels, care should be taken to check for horizontal balance before the wing panels are lifted.

For complete instructions on the installation and removal of an outer wing panel, refer to section IV, paragraph 1.*b.*(1) and *d.*(1).

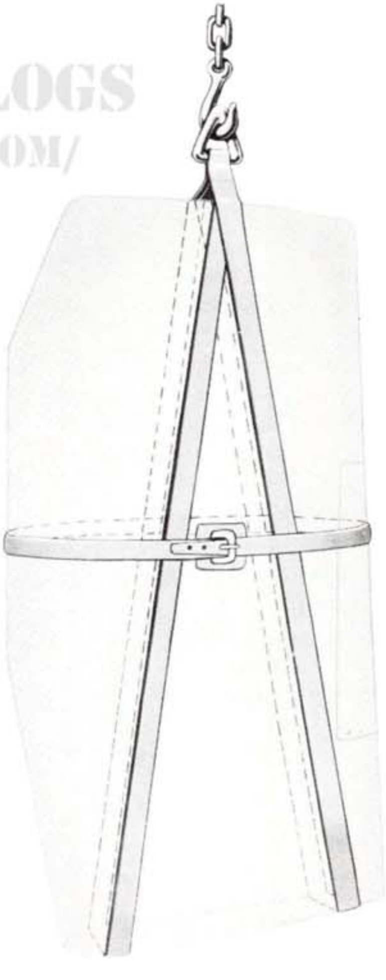


Figure 23—Hoisting Rudder

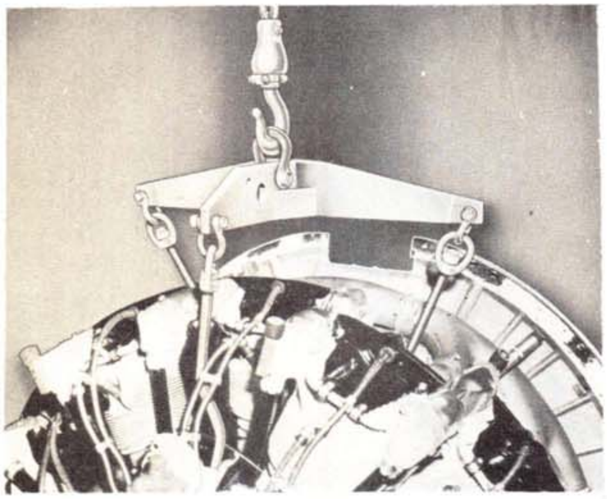


Figure 24—Engine Assembly Sling in Use

CAUTION

In every case, the capacity and suspension of overhead hoisting equipment must be carefully checked before it is used, and specific authority for its use must be obtained from the station engineering officer.

(4) HOISTING HORIZONTAL STABILIZER.—A four-cable sling (K10801), shown in figure 21, is useful in the installation or removal of a horizontal stabilizer. Refer to figure 106 for construction details of this sling. Six to eight men can manually install or remove a horizontal stabilizer, in case a suitable sling is not available. Complete instructions for the installation and removal of a horizontal stabilizer are given in section IV, paragraph 2.*b*.(1) and 2.*f*.

(5) HOISTING VERTICAL STABILIZER. — A two-chain sling (K10701) with a fabric loop, shown in figure 22, is useful in the installation or removal of a vertical stabilizer, although four men can manually accomplish either job. To construct this sling, refer to figure 107. Complete instructions for the installation or removal of a vertical stabilizer are given in section IV, paragraph *2.b.(2)*.

(6) HOISTING RUDDER.—This rudder may be handled during installation or removal by a loop-type sling (K10901) and a hoist, as shown in figure 23. Construction details of this sling are given in figure 108. Complete instructions for the installation or removal of a rudder are given in section IV, paragraph 12.*b*.(3) *(b)* and *(d)*.

(7) HOISTING ENGINE ASSEMBLY.—An engine assembly may be lifted by attaching a sling (K13201) to three hoist fittings provided on the engine crankcase, as shown in figure 24. For construction details of this sling, refer to figure 109.

CAUTION

Before attempting to hoist an engine assembly, the entire hoisting equipment must be carefully checked, and specific authority for its use must be obtained from the squadron engineering officer.

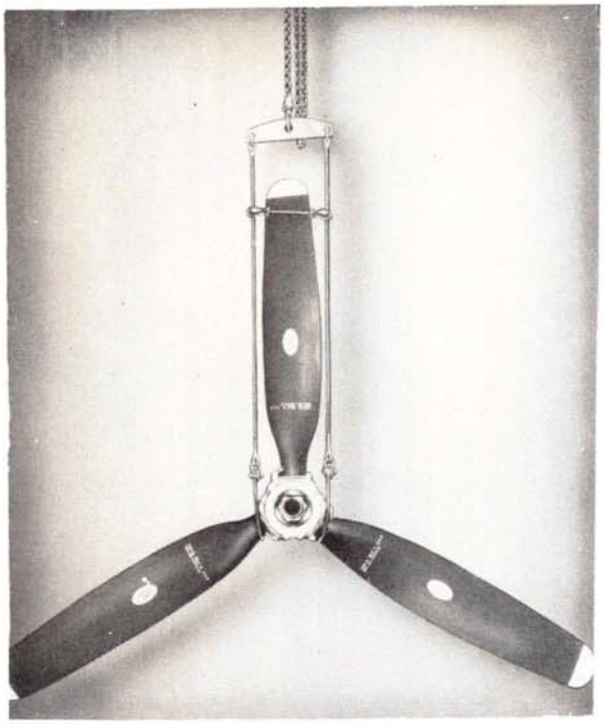


Figure 25—Two-Loop Sling Lifting Propeller in Vertical Position

Detailed procedure to be followed in the installation or removal of an engine assembly is contained in section IV, paragraph 6.*b*.(1)*(b)*.

(8) HOISTING PROPELLER.—Two slings are available to lift the propellers of this airplane. One is a two-loop sling used in lifting a propeller from a vertical position, as shown in figure 25. The other sling is constructed with three loops and is used in raising a propeller from a horizontal position, as shown in figure 26.

b. JACKING PROVISIONS.—Both forward and aft sections of the airplane may be raised by jacks at points which are adequately protected with jack pads. The forward section may be raised by using either of two sets of jacking points, and an alternate emergency method of raising a single main wheel is also provided. The tail section is raised by using only one jacking point. The location of all jacking points is indicated in figure 43.

CAUTION

Do not attempt to jack this airplane without observing the following applicable precautions:

(1) JACKING FORWARD SECTION.

Note

Parking brakes should be off and the tail

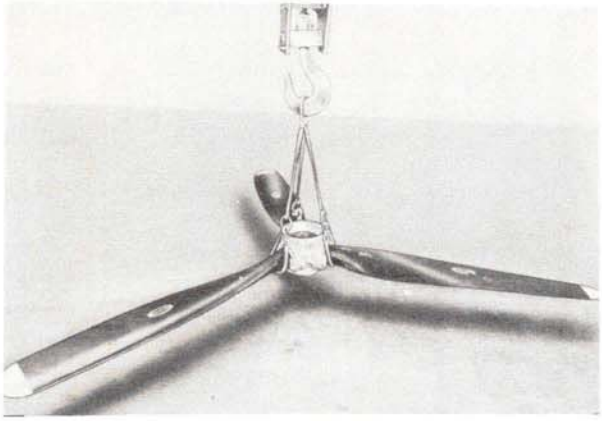


Figure 26—Three-Loop Sling Lifting Propeller in Horizontal Position

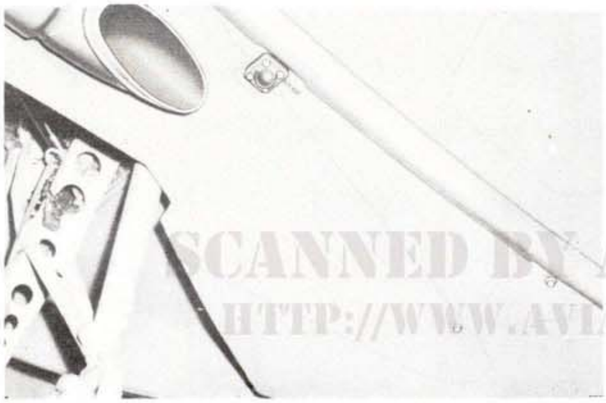


Figure 27—Wing Jack Pad and Two Auxiliary Lifting Points

wheel should be locked when either the forward or the tail section of the airplane is jacked. (Directions for setting and releasing parking brakes are given in paragraph 2.*c.*(1), this section, and directions for locking and unlocking the tail wheel are given in paragraph 2.*c.*(2), this section.)

(a) USING WING JACKS.—Wing jacks provide the most satisfactory method of jacking the forward section of the airplane. Before wing jacking is attempted, the airplane must be stripped of cargo and some fuel, if necessary, so that the gross weight is not more than 21,000 pounds. Two wing jacks are installed, one under either wing, so that both sides can be raised simultaneously.

CAUTION

Do not attempt to raise the forward section of the airplane by using one wing jack only. Install both wing jacks, and raise both sides of the forward section simultaneously.

The two main jack pads are located on the bottom surface of the center wing section outboard of each nacelle, under the front spar. There is only one main jack pad at each of these two locations. (See figure 43.) Most wing jacks are equipped with braces which, in addition to engaging the main jack pad, also engage two jacking points approximately 36-inches aft of each main jack pad, under the center spar. The wing jacking points on one side of the airplane are shown in figure 27. As can be seen in this photograph, the two aft positions are plugged with screws. These screws are removed when a jack with two lifting braces is used so that the braces may be attached to the center spar.

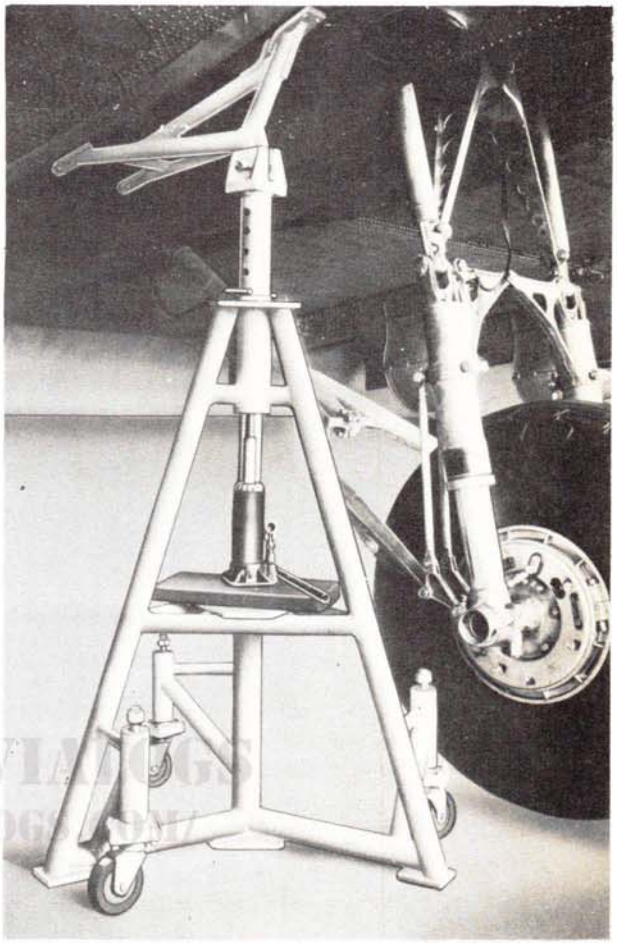


Figure 28—Wing Jack Installed

Note

When using a wing jack with a single lifting surface, it must always be engaged with the main jack pad. The two auxiliary jacking points on the center spar are used only when jacks are equipped with auxiliary lifting braces.

Figure 28 shows a wing jack installed. The jack stand may be used as a shoring device if the safety pin is first placed in position so that the jack can be removed. (For other methods of wing shoring, refer to paragraph 2.*b.*(1)*(d),* this section.) The safety pin

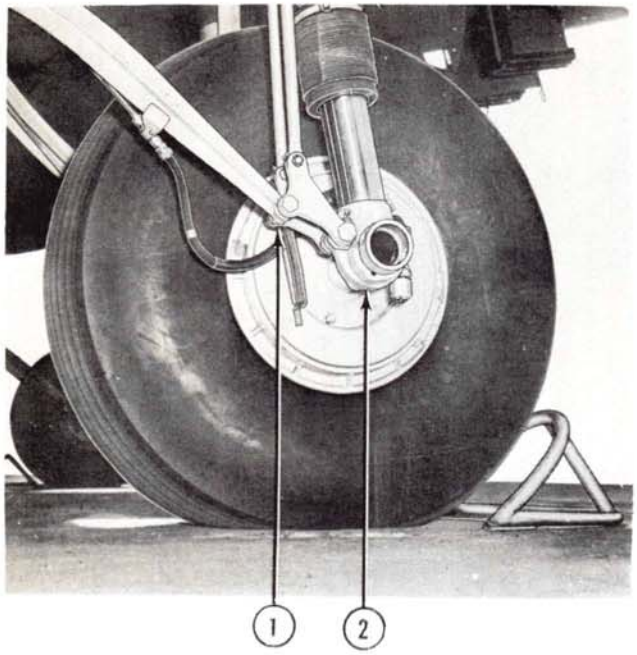


Figure 29—Main Landing-Gear Jacking Points

1. Rear Brace Strut Jacking Point.
2. Main Gear Axle Jacking Point.

should always be used as a precaution against hydraulic failure, after the airplane has been raised to the height required, even though the jack is not removed from the stand assembly.

CAUTION

> Be sure that jack supporting stands, and any other equipment used in the jacking procedure are of sufficient capacity to support the airplane safely. If in doubt about the use of any equipment, consult the Station Engineering Officer.

The shock strut restraining link assembly (Douglas part No. 2140682) is a helpful device which may be used with wing jacks. One function of these link assemblies is to conserve jacking range, which increases jacking stability. For complete instructions regarding their installation, see figures 30, 31, 32, 33, 34, and 35, and refer to paragraph 2.*b*.(1)*(a)1.*, this section.

CAUTION

> Do not attempt to raise a main wheel by landing-gear rear brace strut jack pads unless wing shoring is used as a safety precaution.

It is impossible to retract a landing gear when its rear brace strut is used for support. However, many other jobs, such as servicing wheel bearings, tires, and brakes, can be satisfactorily accomplished when a main wheel is raised by this method. It is necessary to install a shock strut restraining link assembly when the knuckles at the forward ends of a rear brace strut are used as jacking points. (See figures 29 and 43.)

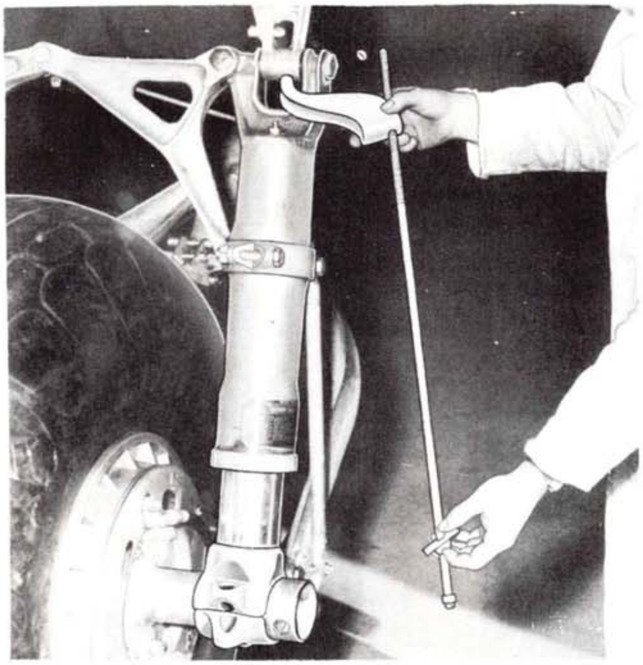


Figure 30—Shock Strut Restraining Link Ready for Installation

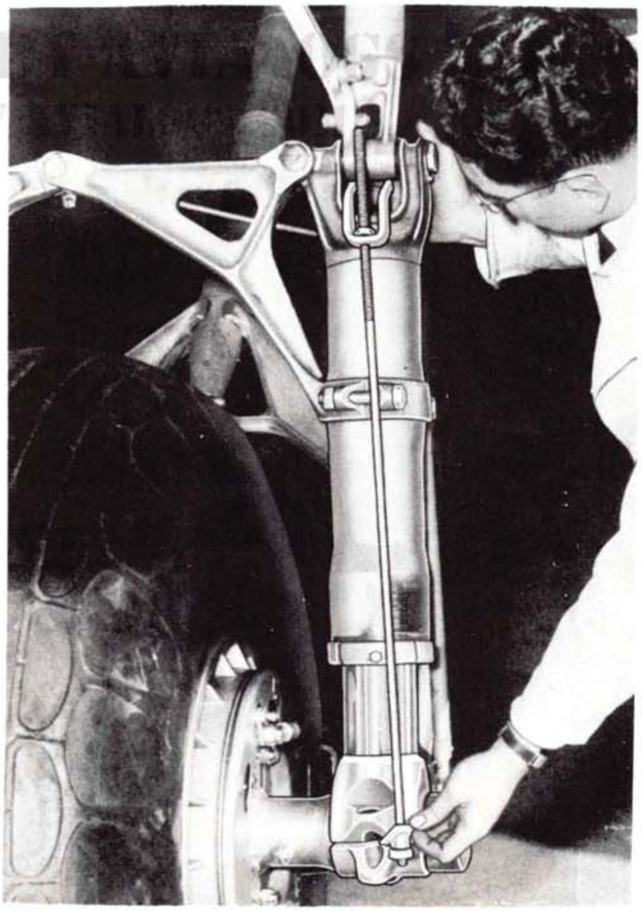


Figure 31—Shock Strut Restraining Link Hooked in Position

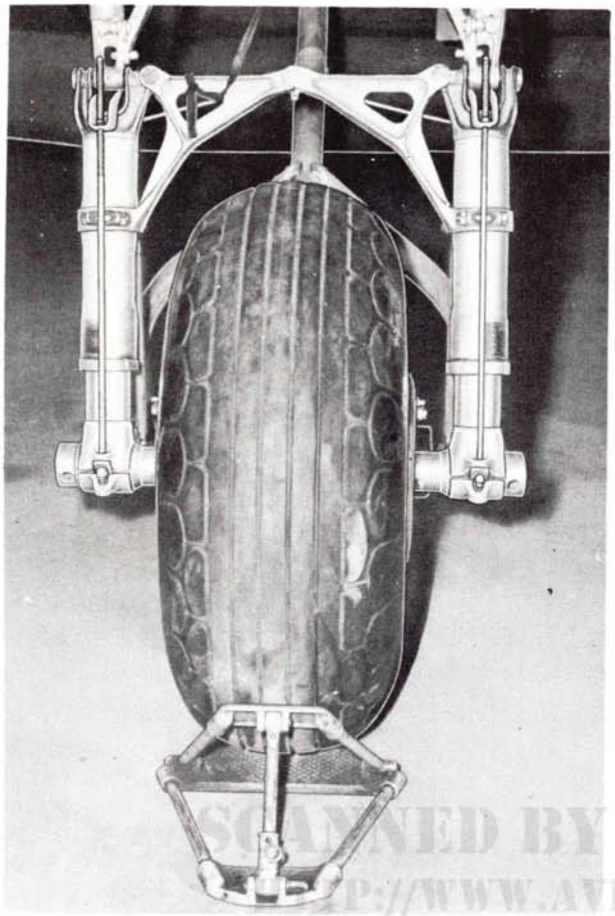


Figure 32—Two Shock Strut Restraining Links Installed

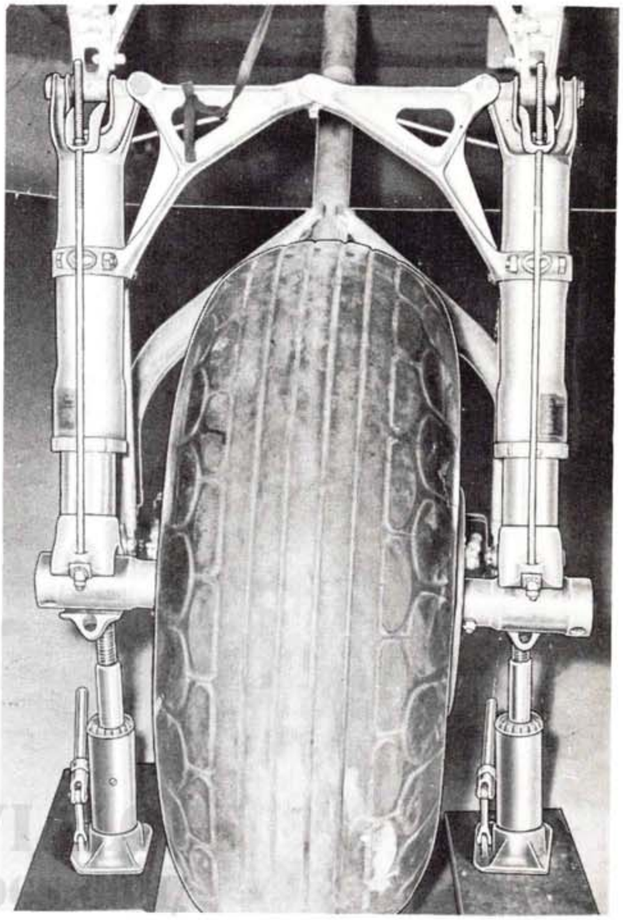


Figure 33—Jacks Installed at Knuckles of Rear Brace Strut

Complete instructions on the use of a shock strut restraining link assembly are given in the paragraph following.

CAUTION

> Do not attempt to jack a main wheel of the airplane by the knuckles at the forward ends of the landing-gear rear brace strut without first installing two oleo strut restraining link assemblies.

1. SHOCK STRUT RESTRAINING LINK ASSEMBLY.—The shock strut restraining link assembly (Douglas No. 2140682), shown in figures 30, 31, 32, 33, 34, and 35, is installed and used when the forward section is raised by wing jacks, or when a wheel is raised by short jacks placed under the forward Y-ends of the rear brace strut. One end of the assembly is hooked into the top of the air-oil shock strut. The other end is bolted to the upper half of the main axle housing after the bottom half has been disengaged. Figure 32 shows two of these assemblies installed, one forward of each shock strut. These assemblies must always be installed in pairs, as shown in figure 32. Figures 33 and 34 show jacks installed under rear brace strut jack pads.

CAUTION

> In all cases, shock strut restraining link assemblies must be installed in pairs, one for each of the two shock struts on each main wheel.

Air-oil shock strut restraining links have two separate functions. They prevent the shock struts from distending when upward pressure is applied to the jacking points at the knuckles of the rear brace strut; therefore, because of a leverage action between the shock struts and the knuckles, they prevent the knuckles from raising without lifting the main wheel. If shock strut restraining links were not installed and an attempt were made to raise a main wheel by its rear brace strut jack pads, the effect would be to raise the rear brace strut ends at an angle outward from the vertical lifting force of the jacks until the jacks finally became unseated. These restrainers also perform a useful role when wing jacks are used. Their function, during wing jacking, also is to keep the shock struts from extending (due to the weight of the wheel) when upward pressure is applied to the wing jack pads, with the result that the wheel rises from the ground immediately after the wing jack is put in operation, thus conserving the lifting range of the jack.

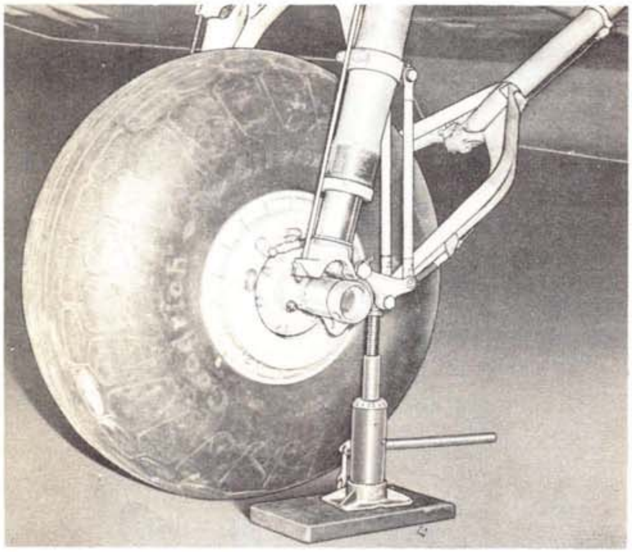


Figure 34—Wheel Ready for Removal

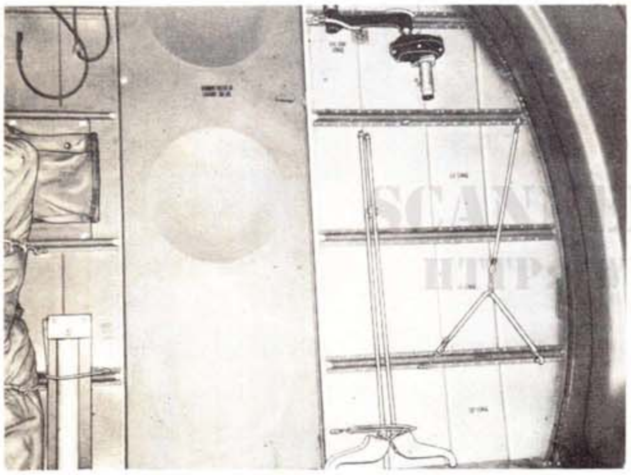


Figure 35—Shock Strut Restraining Links Stowed

Note

> Since it is necessary to disengage the bottom half of the axle housing in order to install a shock strut restraining link, it would be impossible to make a thorough check of landing-gear operation while these restraining link assemblies were installed, because such a check requires that the wheels be mounted. Therefore, restraining link assemblies must not be used when a thorough check of the landing gear is accomplished (as during 50-hour inspection).

Two shock strut restraining link assemblies are carried in the airplane on the forward wall of the aft cargo bulkhead, as shown in figure 35.

(b) JACKING BY MAIN WHEEL AXLES.—Another method of raising a main wheel, when neither wing jacks nor hoists are available, is to use two short jacks under the main wheel axle. The jacking points for this procedure are located at the bottom of the axle housing, below the air-oil shock struts, as shown in figures 29 and 36. Service jobs which can be accomplished when a main wheel is raised in this manner are limited. Since the axle housings are trapped by the jacks, it would be impossible to remove a main wheel; therefore, it would be impossible to service main wheel bearings, brakes, or tires. If it is necessary to remove a main wheel where hoists, or wing jacks, or shock strut restraining link assemblies are not available, proceed as follows:

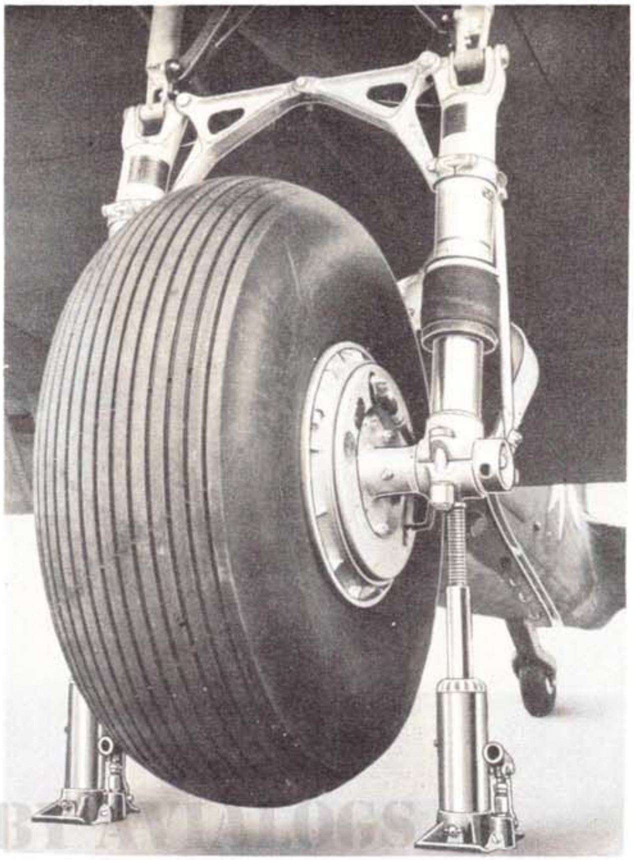


Figure 36—Jacks Installed at Main Wheel Axle

1. Using two short jacks, one on either side of the wheel, jack the wheel by the axle ends.

2. Support the raised wing with shoring.

Note

> Refer to paragraph 2.*b*.(1)*(d),* this section, for emergency shoring methods.

3. Remove the two jacks.

4. Remove the wheel and accomplish whatever servicing is required.

5. Rejack the wheel and remove the shoring.

6. Remove the jacks.

CAUTION

> All precautions pertaining to wing jacking and shoring also apply here.

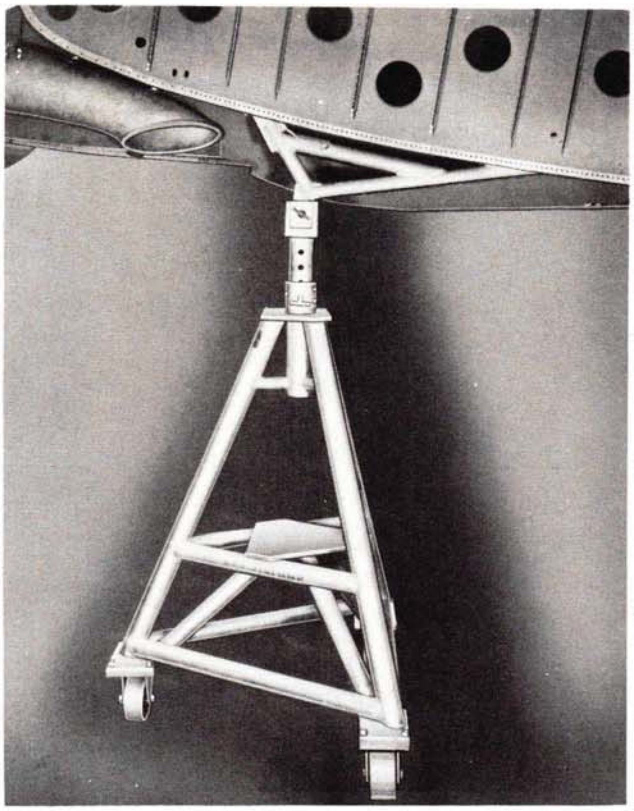


Figure 37—Wing Stand Installed

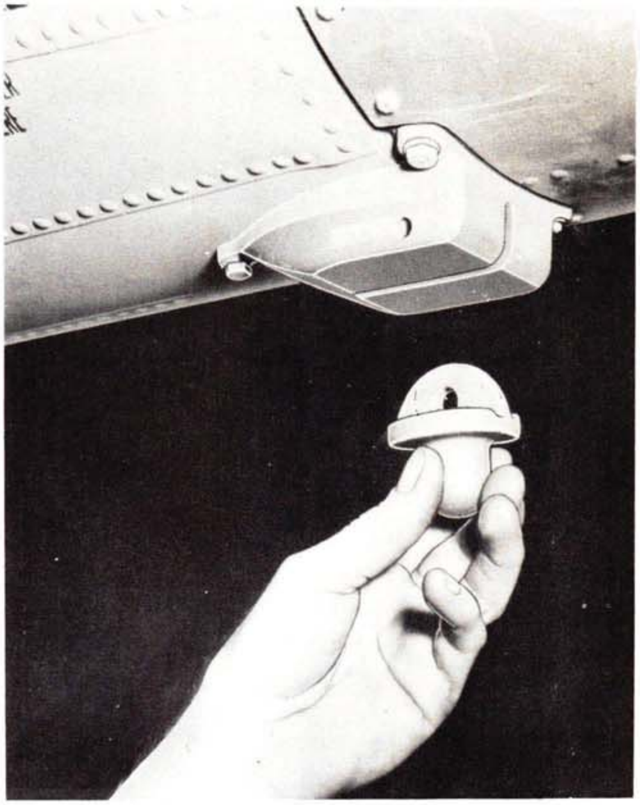


Figure 38—Installing Tail Jack Cone

(*c*) ADDITIONAL JACKING PRECAUTIONS.

1. Do not attempt to jack this airplane on uneven ground. First move the airplane to a level area. The jacks must also be seated upon a level surface.

2. Always head the airplane *down wind.*

3. Do not attempt to jack the airplane when it is exposed to winds of more than 15 miles an hour.

4. Prevent any movement of the airplane while it is resting on jack pads.

5. If the airplane is to be unattended for any length of time while being supported, be sure no ladders or other equipment are left in such a position as to cause damage to the airplane. Also safety wing jacks with pins.

6. Whenever wing jacks are utilized in such a manner that failure of a jack could result in injury to personnel or damage to the airplane or other property, or removal of airplane parts, such as stressed skin plates, could result in damage to the aircraft, added protection will be provided in the form of suitable trestles, stands, shoring, chain hoists or other adequate supporting devices. All protection devices when applied to the under side of the airplane will be of the required height, padded in the areas contacting the airplane and will have sufficient supporting surface to allow support of the airplane without damage to the airplane. Overhead supports, such as chain hoists, will be applied only to those upper portions of the airplane which are designated as lifting points.

7. Secure the airplane to prevent yawing movements while it is on jacks. This may be accomplished by mooring the wings, as instructed in paragraph 2.*c.,* this section.

8. When jacking the forward section and tail section in one procedure, raise both sections evenly so that the fuselage remains approximately in the normal inclined position. Excessive lifting by either forward jacks or tail jack will tend to unseat the jack.

9. When jacking the forward section only, make provision for the tail wheel to move ahead as the forward section is raised.

(d) SHORING METHODS. — Besides wing stands and tail stands, as shown in figures 37, 40 and 41, other suitable means of shoring include:

1. Heavy timber cribbing with top members felt padded and snugly fitted under the wing spars along 3 or 4 feet of span.

2. Large felt padded timbers fitted to the chordwise contour of the wing, extending several inches to the front and rear of the spars, and supported with wooden horses or stands of sufficient strength.

3. Suitably strong benches upon which sand bags have been placed to bear against the wing spars.

CAUTION

Shoring must be placed *only under the center wing* section, and must not be located so far outboard that it interferes with the retraction of the landing gear.

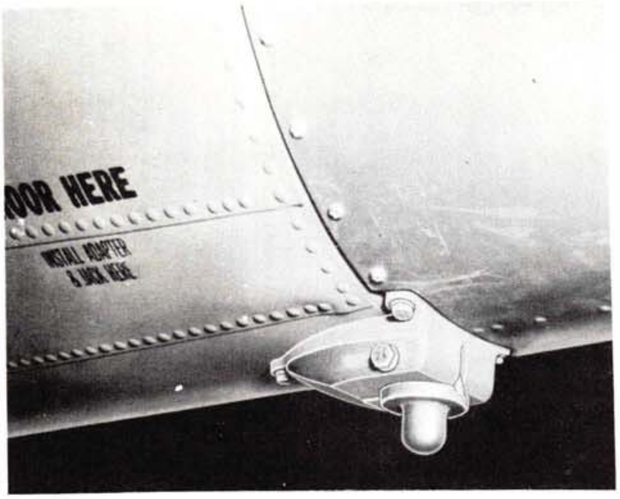


Figure 39—Tail Jack Cone Installed

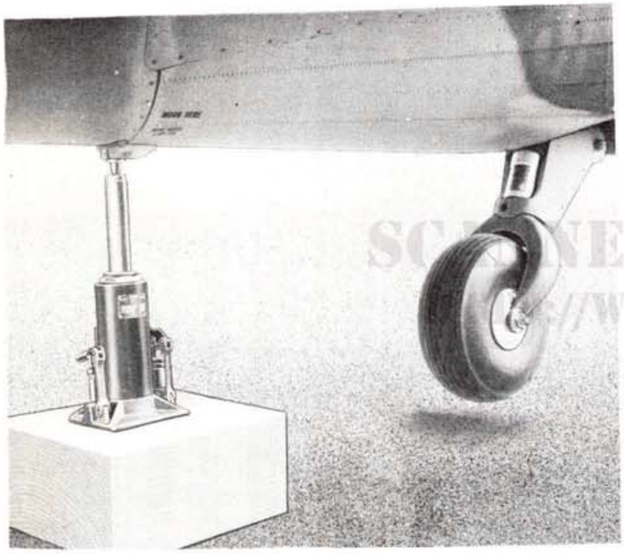


Figure 40—Jack Installed at Tail

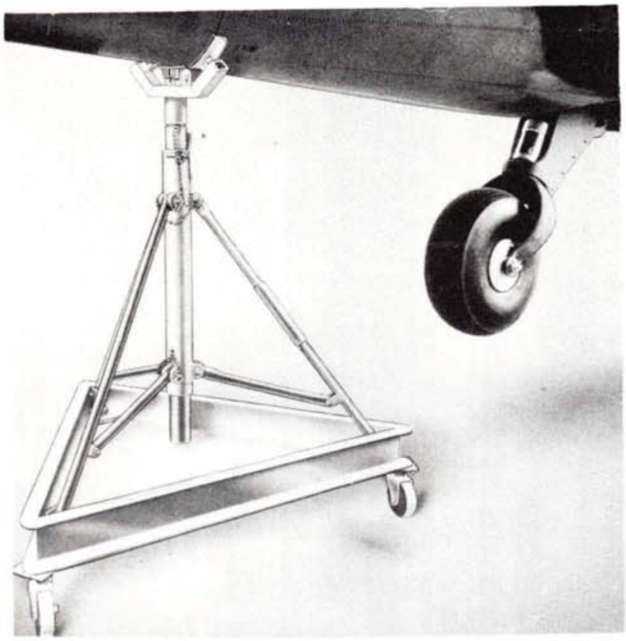


Figure 41—Collapsible Tail Stand Installed

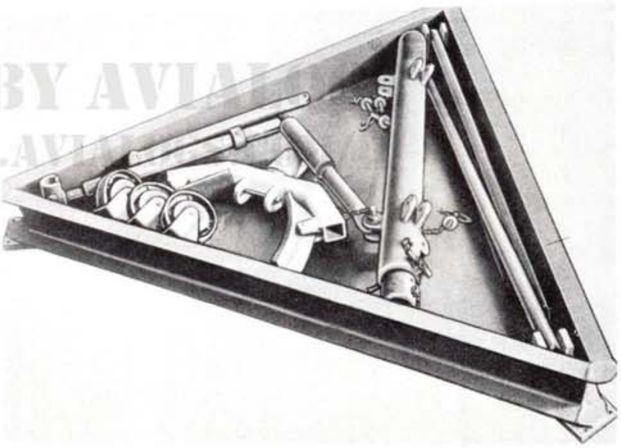


Figure 42—Tail Stand (Collapsible Type) Collapsed

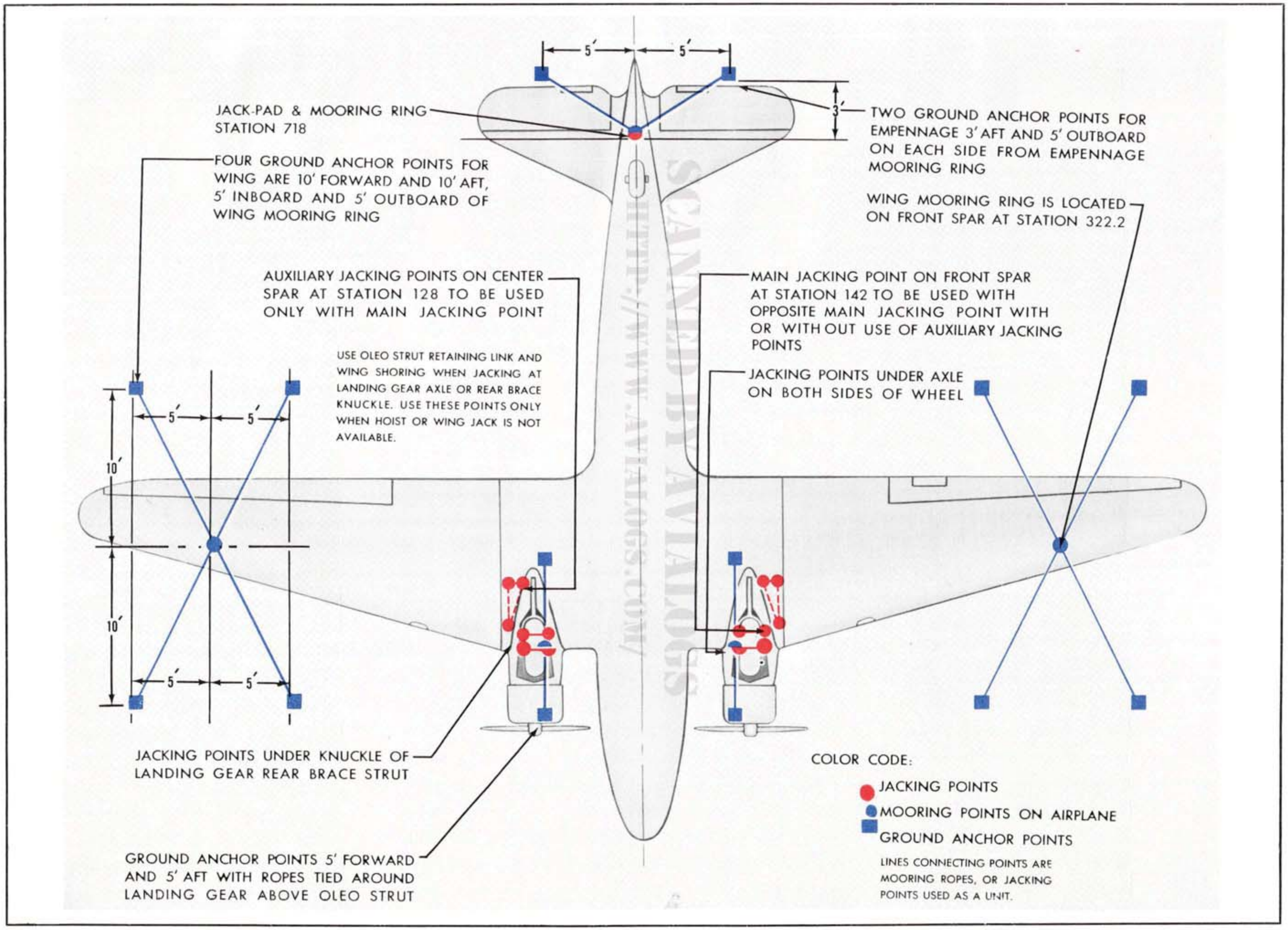
(2) JACKING TAIL SECTION.—The tail section may be raised by engaging a jack with the jury tail skid, a permanently installed casting located on the bottom of the fuselage forward of the tail cone. (See figure 43.) To increase jacking stability, a jack cone (Douglas part No. 2139438), as shown in figures 38 and 39, is attached to the permanent fitting. This part is carried in a canvas container (figure 35), on the forward side of the aft cargo bulkhead. Figure 40 shows the tail jack in lifting position with the auxiliary jack pad installed. It is difficult to jack the tail section to any great height when the forward section is not to be raised at the same time. The top of the jack moves aft as it raises upward; therefore, to counteract this action, the jack should be inclined slightly forward before it is put into operation. Ordinarily a tail section should be jacked no higher than 5 to 7 inches, which is sufficient height to permit servicing of the tail landing gear. When raising the tail section so that the airplane is in level flight position, as is required when weighing the airplane, a tail hoist (figures 14 and 15) must be used.

CAUTION

Do not attempt to jack the tail section high enough to put the airplane in level flight position, as is required during weighing. Use a hoist, instead of a jack, for this purpose.

(a) TAIL STAND.—A collapsible tail stand is available to support the tail section (K12402, with head K13301), as shown in figures 41 and 42. Construction details of the collapsible tail stand are given in figure 104.

c. PARKING INSTRUCTIONS AND MOORING PROVISIONS.—Various precautions are taken to protect the airplane when it is parked unattended either



JACK-PAD & MOORING RING
STATION 718

FOUR GROUND ANCHOR POINTS FOR WING ARE 10' FORWARD AND 10' AFT, 5' INBOARD AND 5' OUTBOARD OF WING MOORING RING

AUXILIARY JACKING POINTS ON CENTER SPAR AT STATION 128 TO BE USED ONLY WITH MAIN JACKING POINT

USE OLEO STRUT RETAINING LINK AND WING SHORING WHEN JACKING AT LANDING GEAR AXLE OR REAR BRACE KNUCKLE. USE THESE POINTS ONLY WHEN HOIST OR WING JACK IS NOT AVAILABLE.

JACKING POINTS UNDER KNUCKLE OF LANDING GEAR REAR BRACE STRUT

GROUND ANCHOR POINTS 5' FORWARD AND 5' AFT WITH ROPES TIED AROUND LANDING GEAR ABOVE OLEO STRUT

TWO GROUND ANCHOR POINTS FOR EMPENNAGE 3' AFT AND 5' OUTBOARD ON EACH SIDE FROM EMPENNAGE MOORING RING

WING MOORING RING IS LOCATED ON FRONT SPAR AT STATION 322.2

MAIN JACKING POINT ON FRONT SPAR AT STATION 142 TO BE USED WITH OPPOSITE MAIN JACKING POINT WITH OR WITH OUT USE OF AUXILIARY JACKING POINTS

JACKING POINTS UNDER AXLE ON BOTH SIDES OF WHEEL

COLOR CODE:

- ● JACKING POINTS
- ● MOORING POINTS ON AIRPLANE
- ■ GROUND ANCHOR POINTS

LINES CONNECTING POINTS ARE MOORING ROPES, OR JACKING POINTS USED AS A UNIT.

Figure 43—Jacking and Mooring Points

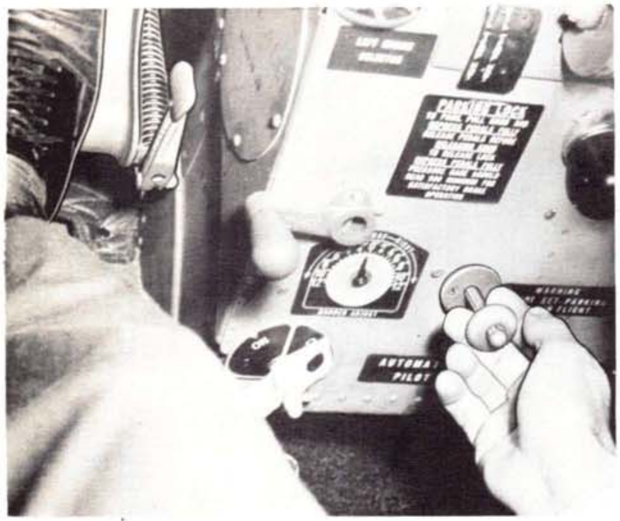


Figure 44—Setting Parking Brakes

for a few minutes or for several days. Protective measures include setting the parking brakes, locking the tail wheel in fore and aft position, locking the control surfaces with external locks, checking the wheels, and mooring the airplane either to permanent or temporary mooring installations. In addition to these precautions, protective covers for propellers, nacelles, wings, and other parts of the airplane are available and should be used under various parking conditions.

(1) SETTING PARKING BRAKES.—The parking brakes must be set whenever a pilot or a qualified mechanic is not at the controls in the pilots' compartment, after the airplane has made its landing.

WARNING

Do not set parking brakes too soon after landing. Setting brakes too soon may result in damage to the drums and the brake shoes due to their heated condition.

To set the brakes for parking, proceed as follows:

(a) Set the pedals even so that one is not pushed in farther than the other.

(b) Depress the brake pedals with the toes.

(c) Pull out the parking brake control. (See figure 44.)

(d) The hydraulic gage must show at least 500 psi when the airplane is parked.

(e) To release parking brakes, it is necessary only to depress the pilot's brake pedals.

Note

Parking brakes can be set from the pilot's seat only. Parking brakes cannot be set from the copilot's seat.

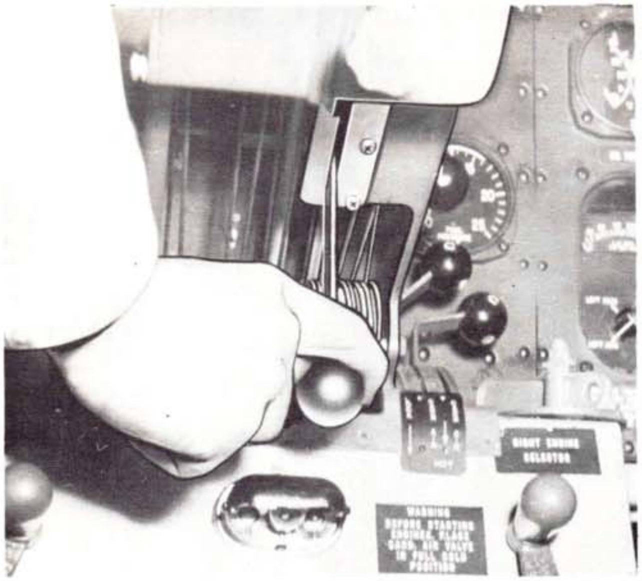


Figure 45—Locking Tail Wheel

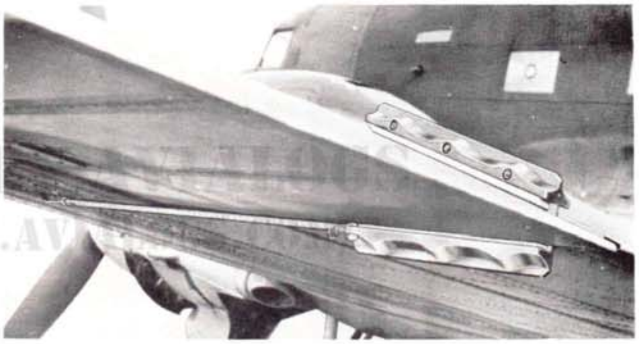


Figure 46—Aileron Lock Installed

(2) LOCKING TAIL WHEEL.—The tail wheel is locked in fore and aft position (the only position in which it can be locked) by pushing forward the plunger-type control in the lower section of the control pedestal, as shown in figure 45. The tail wheel is unlocked by pulling out the control to the extent of its range.

Note

The tail wheel will not lock as a result of pushing the control forward unless the tail wheel is aligned in the fore and aft position. If the control is pushed forward, the wheel will lock as soon as it becomes properly aligned. Occasionally the tail wheel will not unlock by pulling out the control. It is a wise precaution to make a check to determine whether or not the control has unlocked the tail wheel.

In all cases the tail wheel must be locked during parking, mooring, and jacking of the airplane, during take-off and flight, and during landing. Ordinarily the tail wheel must be unlocked only during taxying, and during ground handling involving turns. Turning, without first unlocking the tail wheel, may result in breaking the locking pin or damaging the wheel assembly.

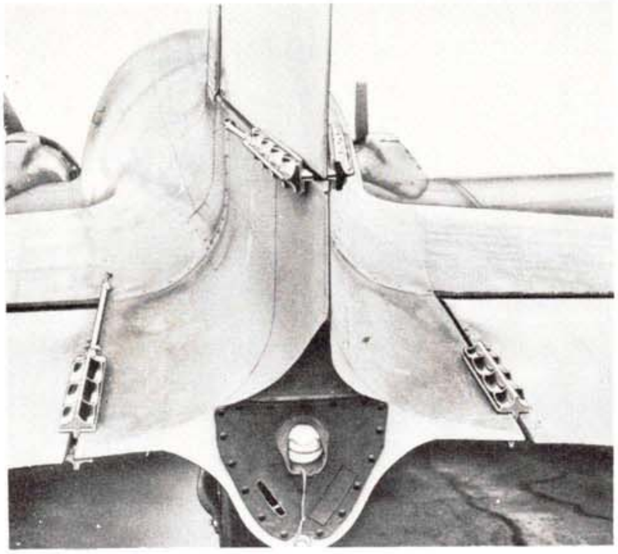


Figure 47—Rudder and Elevator Locks Installed

(3) LOCKING FLIGHT CONTROLS.–When this airplane is parked outside a hangar, external control surface locks must be installed on the rudder, on both ailerons, and on both elevators.

CAUTION

External control surface locks must be installed whenever this airplane is left unattended, regardless of weather conditions.

The purpose of control surface locks is to prevent damage to control surfaces which may result either from winds or from the propeller blasts of other aircraft. If this airplane is caught either by violent winds or propeller blasts, whether or not control surface locks are installed, preflight inspection of controls must be accomplished before take-off.

The control surface locks supplied with the airplane are of the usual plywood, felt padded type, equipped with small bungees which hold them firmly in position. Figure 46 shows an aileron lock installed, while figure 47 shows a rudder lock and two elevator locks installed. The three locks are not interchangeable, and right and left aileron locks, or right and left elevator locks, are not interchangeable. When not in use, the locks are carried in the lavatory compartment of the airplane. (Refer to paragraph 16.*d.*(16), section IV.)

WARNING

To insure that all control locks are removed before take-off, the following notation is placed in the "Before Take-off" instructions of the Pilot's Check List: "Check all flight controls for free movement."

No provision is made for locking the control surfaces from the pilots' compartment.

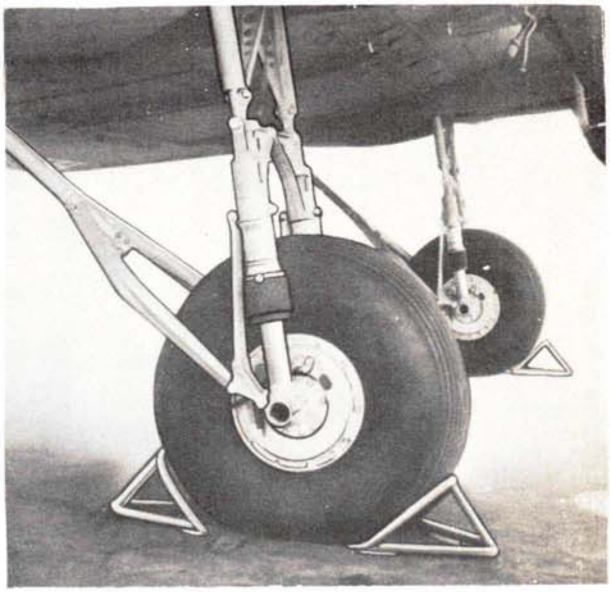


Figure 48—Chocks Installed at Main Wheels

WARNING

The automatic pilot *must not* be used as a means of locking the control surfaces when the airplane is parked or during engine warm-up periods.

(4) CHOCKING WHEELS.–Chocks should be placed fore and aft of both main wheels (figure 48) whenever the airplane is left unattended for any length of time, particularly during overnight parking, and always when the airplane is moored. Chocks should also be placed *in front* of the main wheels during engine testing, or during engine warm-up preparatory to take-off. A chock consists of a wedge-shaped frame of tubular metal. It is placed in position by firmly wedging it into the angle formed by a main wheel and the ground. The purpose of chocks is to keep the airplane from moving on the ground. Chocks must be removed from the wheels before an attempt is made to put the airplane in motion.

(5) MOORING INSTRUCTIONS. – Provisions are made for mooring the airplane so that damage will not result from winds and storms. The mooring points of the airplane are indicated in figures 43 and 49. Either rope or cable may be used for mooring lines. The type D-1 mooring kit (figure 56) is carried in the airplane at the aft bulkhead of the cargo compartment and should be used in emergencies; however, at permanent or semi-permanent locations, a corresponding permanent type of mooring should be provided.

(*a*) PREPARING AIRPLANE FOR MOORING.–Preparatory to mooring the airplane, proceed as follows:

1. Select a level area as the location for mooring.

2. Head the airplane into the wind.

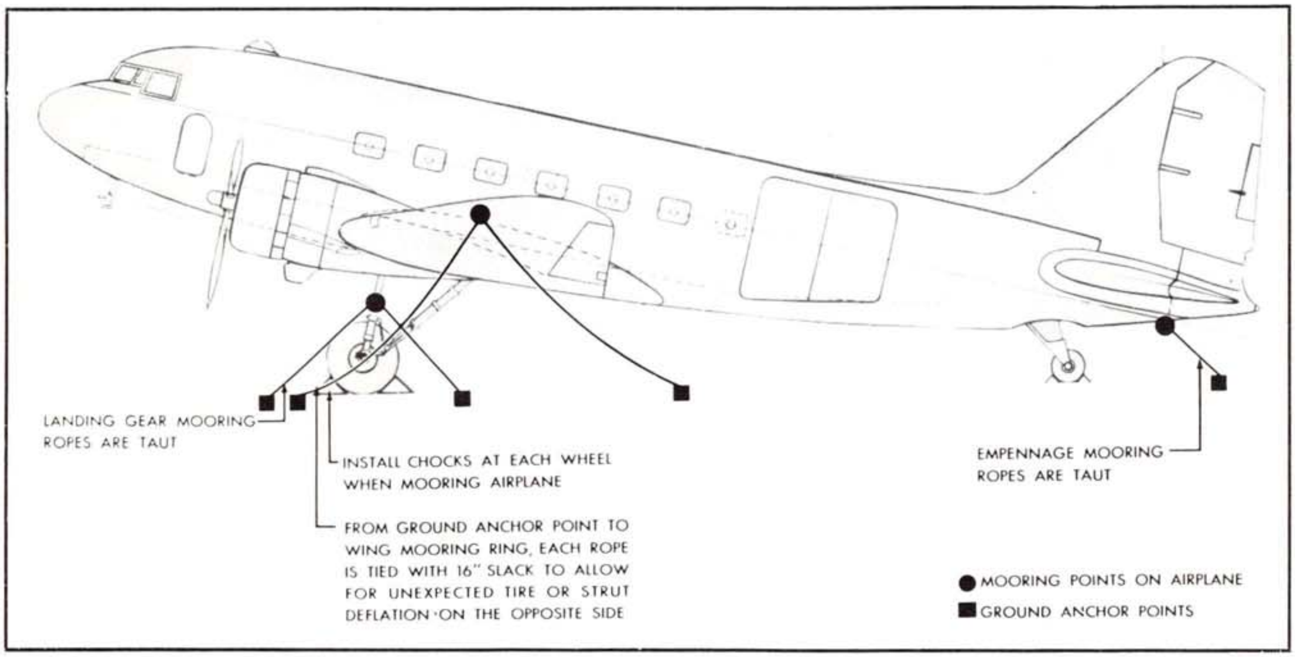

LANDING GEAR MOORING ROPES ARE TAUT
INSTALL CHOCKS AT EACH WHEEL WHEN MOORING AIRPLANE
FROM GROUND ANCHOR POINT TO WING MOORING RING, EACH ROPE IS TIED WITH 16" SLACK TO ALLOW FOR UNEXPECTED TIRE OR STRUT DEFLATION ON THE OPPOSITE SIDE
EMPENNAGE MOORING ROPES ARE TAUT
● MOORING POINTS ON AIRPLANE
■ GROUND ANCHOR POINTS

Figure 49—Side View of Mooring Arrangements

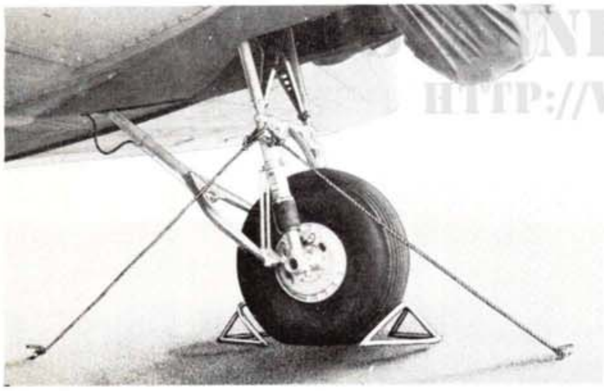


Figure 50—Main Landing-Gear Moored to Permanent Installations

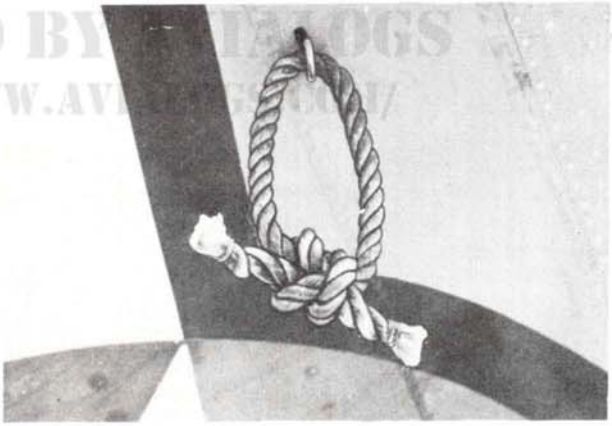


Figure 51—Rope Loop Tied to Wing Mooring Ring

3. Set the parking brakes. (Refer to paragraph 2.*c.*(1), this section.)

4. Install control surface locks on ailerons, elevators, and rudder. (Refer to paragraph 2.*c.*(3), this section.)

5. Lock the tail wheel in fore and aft position. (Refer to paragraph 2.*c.*(2), this section.)

6. Turn the automatic pilot to "OFF" position. (Refer to "WARNING" under paragraph 2.*c.*(3), this section.)

7. Place chocks fore and aft of each main wheel and the tail wheel.

(b) MOORING THE AIRPLANE.

WARNING

Do not attempt to moor this airplane without first making preparations for mooring as outlined in paragraph 2.*c.(5)(a)1.* through *7.*, this section.

1. MOORING LINES.—Either hemp rope or steel cable may be used for mooring lines. If rope is used, it must be of at least 1-inch diameter. Cable must be of at least ⅜-inch diameter. Approximately 200 feet of rope, or cable, is required to moor the airplane if the plan outlined in figures 43 and 49 is followed.

2. MOORING POINTS.—This airplane has five mooring points. (See figure 43.) The two principal mooring points are located on the main landing gear, above each shock strut. Tie-down lugs are not provided; hence, the rope or cable is tied to a fixed portion of the landing gear, as shown in figure 50. Two ropes (or cables), one leading forward and the other aft, are

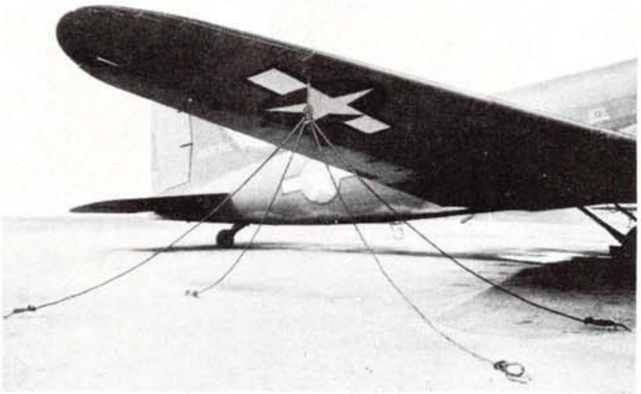


Figure 52—Wing Moored

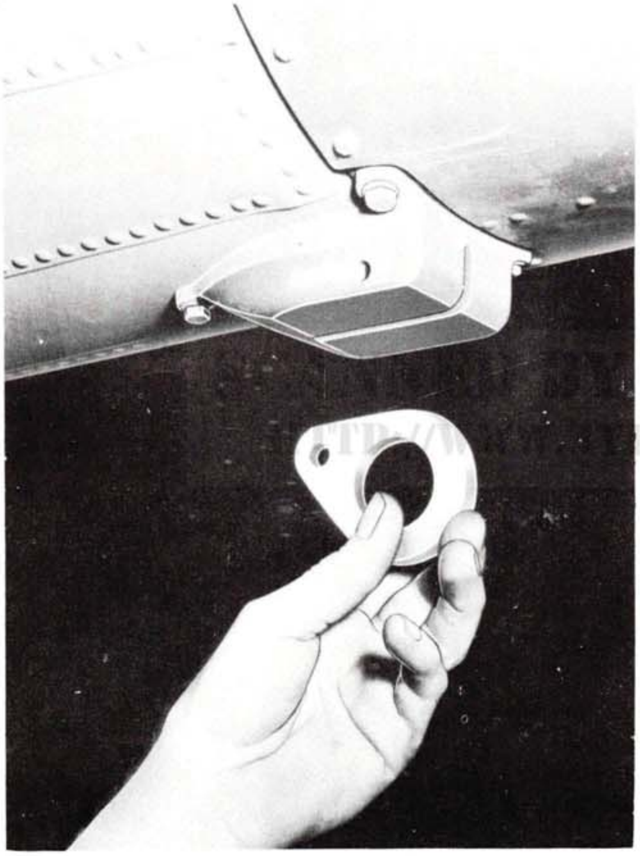


Figure 53—Installing Tail Mooring Ring

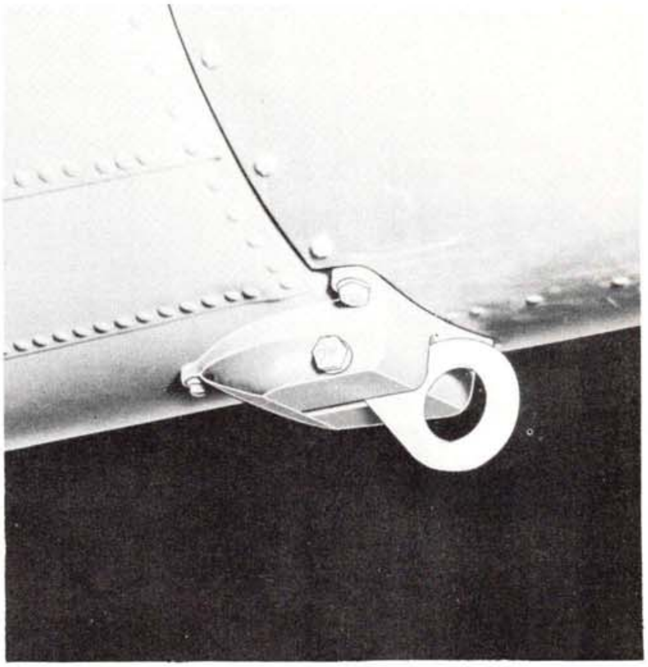


Figure 54—Tail Mooring Ring Installed

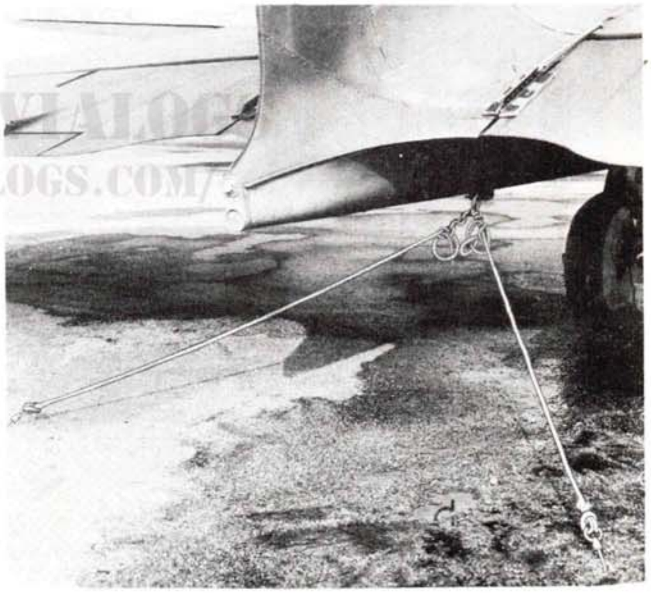


Figure 55—Empennage Moored

tied to each landing gear. When these lashings are anchored, they must be taut. Two mooring points, each of which is a point of attachment for four mooring lines, are located on the bottom surfaces of the outer wing panels, as indicated in figures 43, 49, and 52. The lines are attached to a ring which is secured to the end of a spring-loaded cable. When the ring is not being used for mooring, it automatically retracts into the wing. Since the ring is only 1 inch in diameter, an auxiliary loop, as shown in figure 51, must be employed when 1-inch rope instead of ⅜-inch cable is used for mooring lines. Figure 52 shows a wing moored with 1-inch rope. Unlike the mooring lines at the main landing gear, the wing lines are anchored loosely, with 16 inches of slack in each line. This slack prevents undue stress upon the mooring installation should a tire or a strut on the opposite side of the airplane become deflated. The tail of the airplane is moored to the jury tail skid located aft of the tail wheel. (See figures 49 and 55.) A mooring ring, shown in figure 53, is bolted to the tail side (figure 54), and two mooring lines lead from the ring to the ground anchor points (figure 55). This mooring arrangement is also shown in figure 43 and 49. The tail mooring lines are lashed taut. The mooring ring is stowed in a canvas bag on the forward side of the aft cargo compartment bulkhead.

3. GROUND ANCHOR POINTS.—If the airplane is properly moored, according to the plan given in figures 43 and 49, 14 ground anchor points must be used. An anchor point is located 5-feet forward of each main wheel and 5-feet aft of each main wheel, as shown in figures 43, 49, and 50. Two anchor points are located forward and two are located aft of each wing mooring point as shown in figure 52. (For dimensions of ground anchor points with reference to wing mooring ring, refer to figure 43.) Two anchor points are located aft and outboard of the tail mooring ring, as shown in figures 43, 49, and 55.

4. METHODS OF ANCHORING MOORING LINES.—Five methods of ground anchoring for mooring lines may be used, depending upon the permanency of mooring which is sought and upon weather conditions. One method of ground anchoring is provided by mooring kit type D-1 (figure 56) which is carried in the airplane.

a. ANCHORING WITH ARROWS AND RODS (MOORING KIT TYPE D-1).—Mooring kit type D-1 (figure 56), which is stowed at the aft bulkhead of the cargo compartment (figure 35), contains anchor rods and arrows which are used for ground anchorage in emergency mooring. Five kits are required for mooring this airplane. A single kit consists of the following parts:

PART NO.	NOMENCLATURE	QUANTITY PER KIT
36B4466	Driving Rod	1
36A4468	Anchor Rod	6
36A4469	Anchor Rod Eye	3
38B3323	Ground Breaking Pin	1
36A4467	Mooring Arrow	1
33D2721	Mooring Rope	3
36G4465-1	Canvas Bag	1

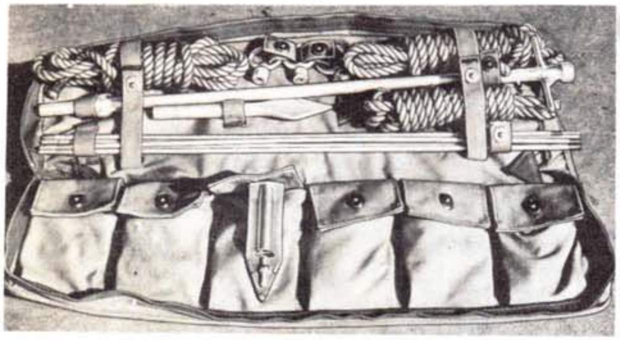


Figure 56—Type D-1 Mooring Kit

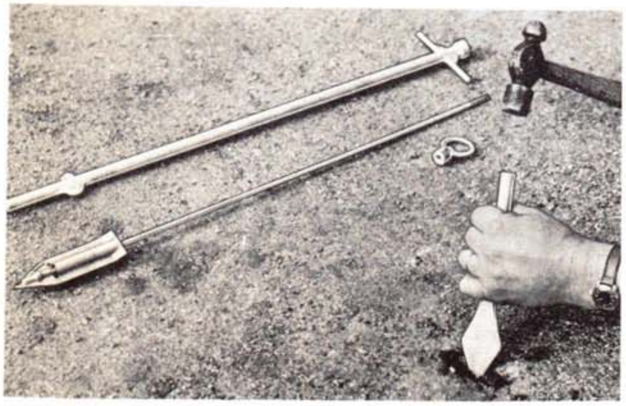


Figure 57—Breaking Ground for Mooring

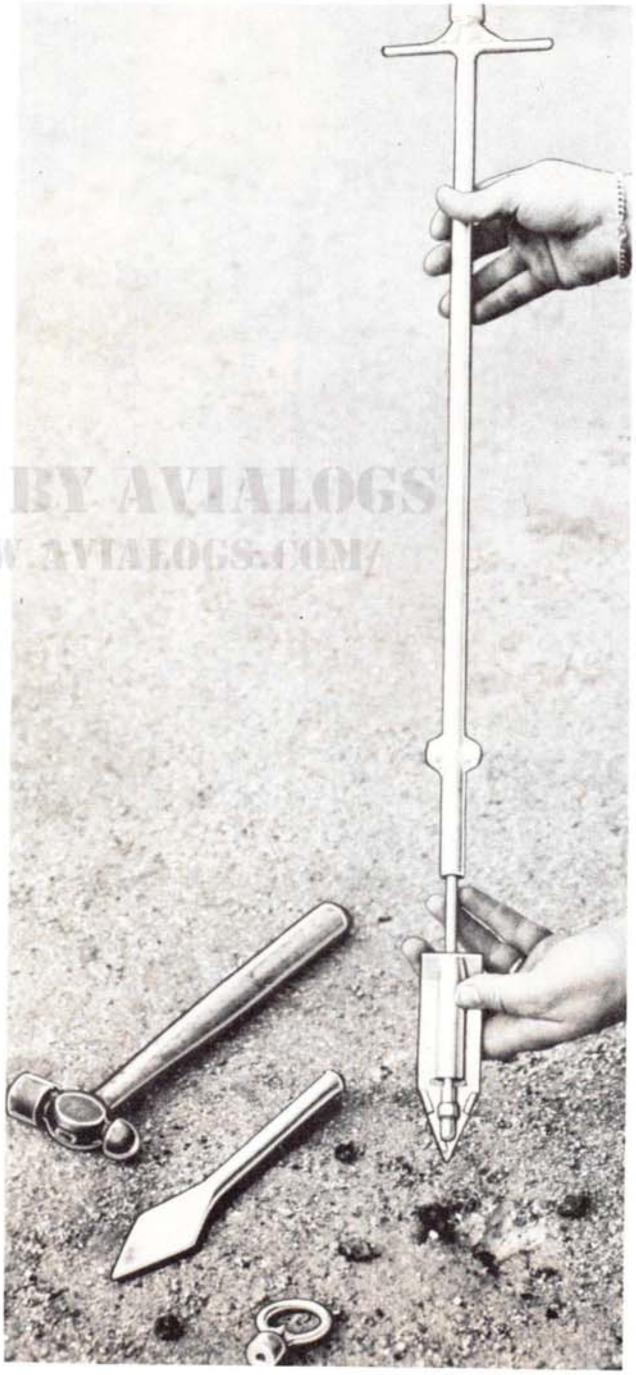


Figure 58—Placing Driving Rod Over Anchor Rod

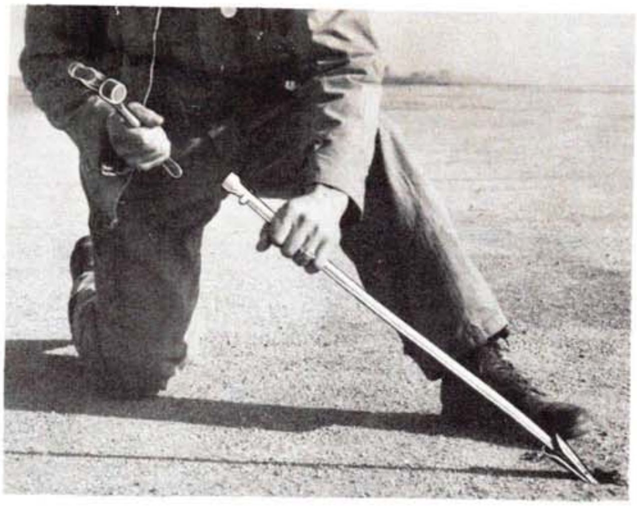


Figure 59—Driving Anchor Rod and Arrow

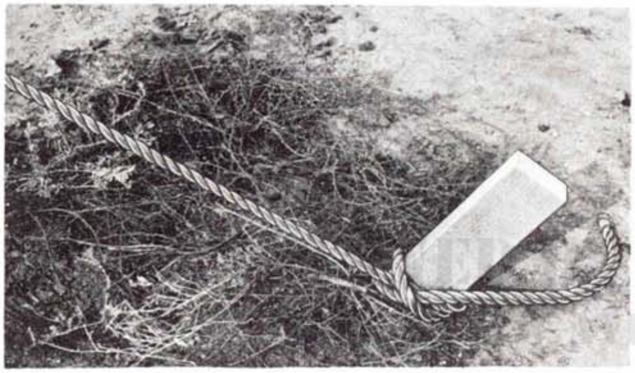


Figure 60—Mooring Stake

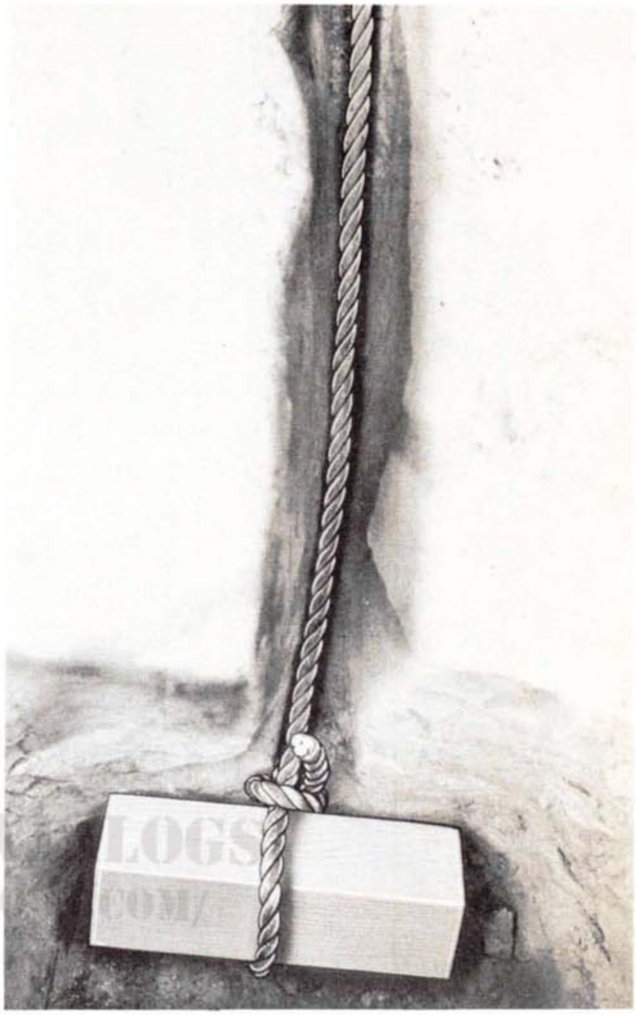


Figure 61—Mooring "Dead Man"

Figures 57, 58, and 59 show how units of this mooring kit are assembled and used. (Mooring anchor rods and arrows are also shown in figures 52 and 55.) The anchor rod is screwed into the arrow, then the driving rod is slipped over the anchor rod (figure 58) and into the socket of the arrow. The cam on the driving rod must be turned so that the prongs of the arrow will not be spread by driving. The ground breaking pin (figure 57) is used to penetrate a hard surface before the anchor rod is driven. Care must be taken to align the rod with the point of attachment on the airplane.

Note

> Be sure that anchor rods are driven into the ground in such a manner that their axes are aligned with the mooring lines to which they are attached.

The arrow is driven into the ground (figure 59) until the driving rod handle is approximately 3 inches above the ground. (See figures 52 and 55.) Then the handle is rotated 90 degrees, and the driving rod is given a sharp blow to spread the prongs of the arrow. The driving rod is then returned to driving position and withdrawn from the ground. The anchor rod eye (to which the mooring line will be tied) is then screwed onto the anchor rod. To withdraw an anchor rod, the mooring lines are detached and the anchor rod unscrewed by turning the ring of the eye assembly counterclockwise, leaving the arrow in the ground. Arrows for this kit are expendable and should be replaced upon return to the home station.

b. ANCHORING WITH STAKES.—For temporary mooring, stakes used similarly to tent pegs may be employed. The stakes should be approximately 3 inches in diameter and 4 to 5 feet long. They should be driven into the ground at an angle not to exceed 30 degrees from the vertical. Unlike the position of anchor rods contained in mooring kit type D-1, the position of stakes should be such that the load imposed by the mooring line will tend to pull the stake into a vertical position, as shown in figure 60. The mooring line should never be aligned with the longitudinal axis of the stake.

WARNING

> Anchor stakes must be driven so that the mooring lines will tend to pull them into a vertical position.

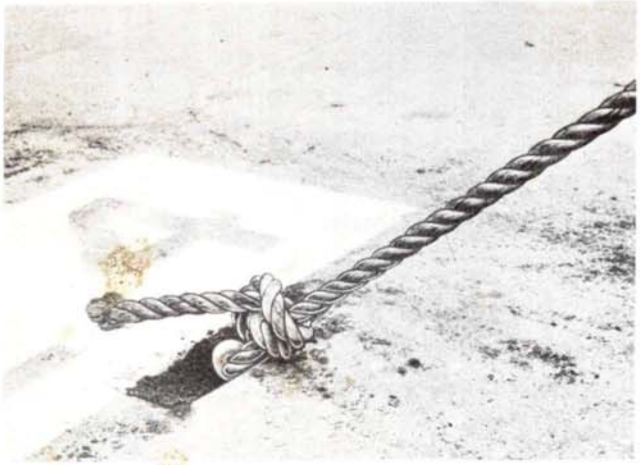


Figure 62—Permanent Mooring Installation

c. ANCHORING WITH "DEAD MAN."—Another type of temporary mooring which may be used in the field is the "dead man" ground anchor. The "dead man" consists of a block of wood at least 12 inches long and at least 3 by 3 inches in width and thickness. An 8- to 10-foot rope or cable (preferably a cable), is firmly attached to the middle of the "dead man." A loop is formed in the other end of the rope (or cable) to which the mooring lines are fastened. The "dead man" is then buried in the ground in such a position that the load imposed by the mooring line will be perpendicular to the "dead man's" longest axis, as shown in figure 61. The depth should be 3 to 6 feet, depending upon the firmness of the ground.

Note

Be sure a "dead man" anchor is buried in such a manner that the mooring line, when drawn taut, points directly to the "dead man."

d. ANCHORING WITH ICE. — During freezing weather, where the ground is extremely difficult to penetrate, three satisfactory methods of ground anchoring may be accomplished.

(1) FIRST METHOD.— Dig holes 8 inches deep and 8 inches square at the proposed anchoring points. Fill the holes with water, then submerge as many coils of rope as possible in the water, allowing the end of the bottom of the coil to protrude. Attach the mooring line to the protruding end of the rope, after the water has frozen throughout.

Note

In constructing an ice anchor, be sure that the protruding end of the rope comes from the bottom of the coil, and not from the top.

(2) SECOND METHOD.—Make the holes as outlined above, and place a 3-inch diameter stake in the hole, leaned cornerwise so that the longest axis of the stake will be as nearly as possible perpendicular to the mooring line. After filling the hole with water and allowing it to freeze, notch the stake where it protrudes from the ice. The mooring line is then tied into the notched position.

(3) THIRD METHOD.—The same size of holes is used as in the two methods above, and the ice-bound anchor consists of a "dead man." (Refer to paragraph 2.*c.*(5)*(b)4*.c., this section.) A short piece of rope is tied to the middle of the "dead man" which is laid in the bottom of the water-filled hole, with the loose end of the rope protruding. After the water has frozen, the rope is attached to the mooring line.

e. ANCHORING TO PERMANENT MOORING INSTALLATIONS.—Permanent anchors for mooring (figures 50 and 62) may be installed on concrete aprons or ramps. Their installation is the responsibility of the Director of Base Services, Headquarters, Army Air Forces. When mooring this airplane to permanent installations, the anchor points should conform as closely as possible to the diagram shown in figure 43.

5. SPOILERS (AN ADDITIONAL PRECAUTION DURING STRONG WINDS).—When warnings of fierce storms or high winds are received, spoilers must be installed on the airplane's wings in order to give added protection to the moored aircraft. A spoiler is a device which is fastened to the upper surface of a wing so that the streamlined airflow passing over the wing will be broken, with the result that the wing will lose most of its lifting effect. The importance of spoilers, during unusually strong winds, will be readily seen, for the moored airplane is headed into the wind, (refer to paragraph 2.*c.*(5)*(a),* this section) and if it were subjected to a wind velocity greater than its stalling speed, it would tend to rise from the ground and overturn. Spoilers prevent this occurring, even though the wind velocity should become greater than the airplane's stalling speed, by robbing the wings of their aerodynamic efficiency.

a. CONSTRUCTION OF SPOILERS.—A spoiler may consist of a wooden two-by-four with a length equal to 75 percent of a single wing. It should be located on the top surface of the wing, parallel to the leading edge, approximately 3-feet aft of the leading edge, with the 4-inch dimension perpendicular to the wing surface. It should also be located in such a manner that little or no space exists between the bottom of the spoiler and the wing surface, and should be clamped on the wing in a manner to avoid damage to the wing skin or the flight controls. When spoilers are used they must be used in pairs, one on either wing.

(6) PROTECTING THE AIRPLANE WITH COVERS.—Various protective covers are provided either with the airplane or from AAF stock, and they should be used under the conditions given in the paragraphs following. Covers provided with the airplane include engine covers, nacelle dust excluders, air filter dust excluders, main landing-gear shock strut covers, cowl flap cylinder dust excluders, aileron actuating

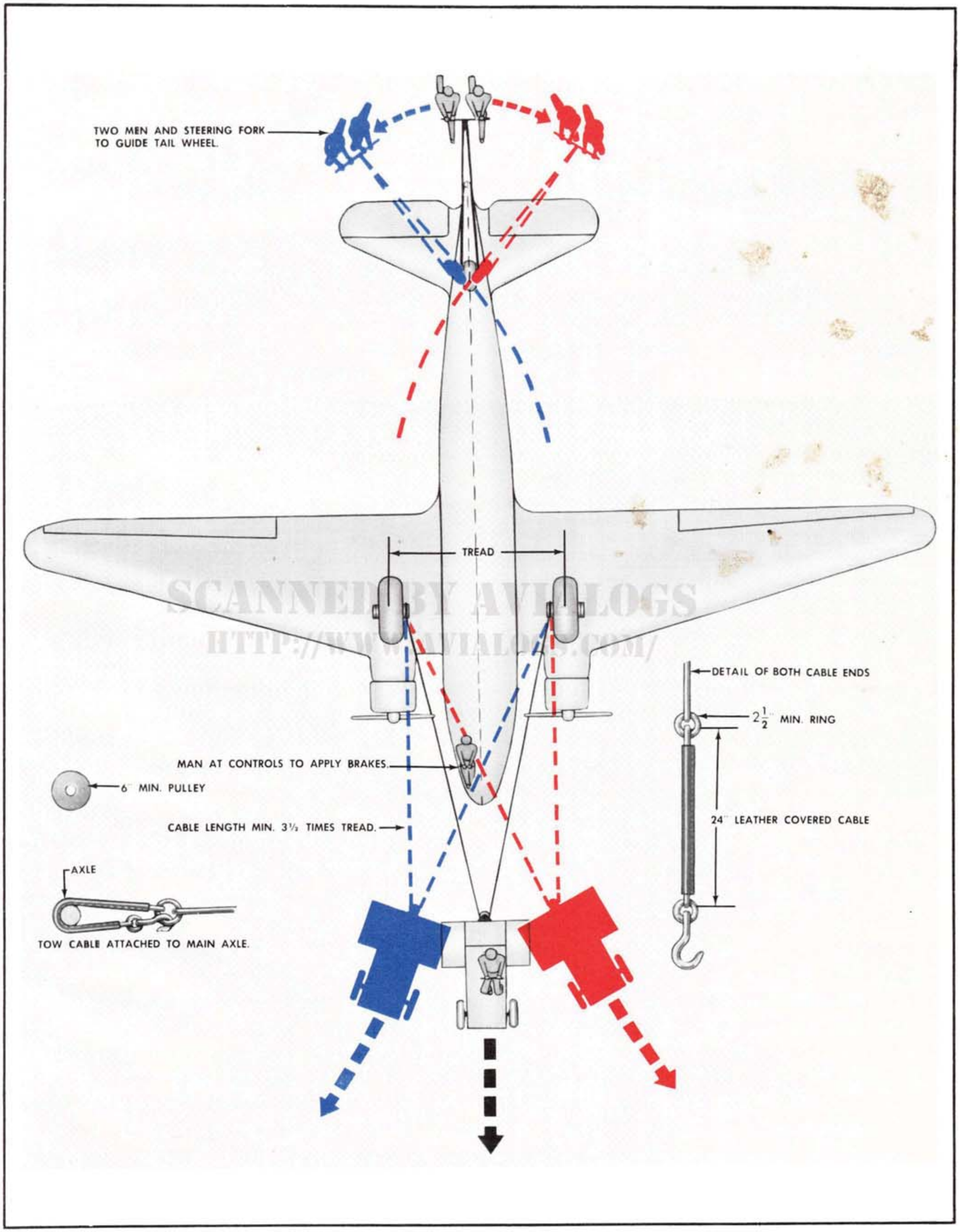

TWO MEN AND STEERING FORK TO GUIDE TAIL WHEEL.
TREAD
DETAIL OF BOTH CABLE ENDS
2½" MIN. RING
MAN AT CONTROLS TO APPLY BRAKES.
6" MIN. PULLEY
CABLE LENGTH MIN. 3½ TIMES TREAD.
24" LEATHER COVERED CABLE
AXLE
TOW CABLE ATTACHED TO MAIN AXLE.

Figure 63—Arrangement for Towing From Front

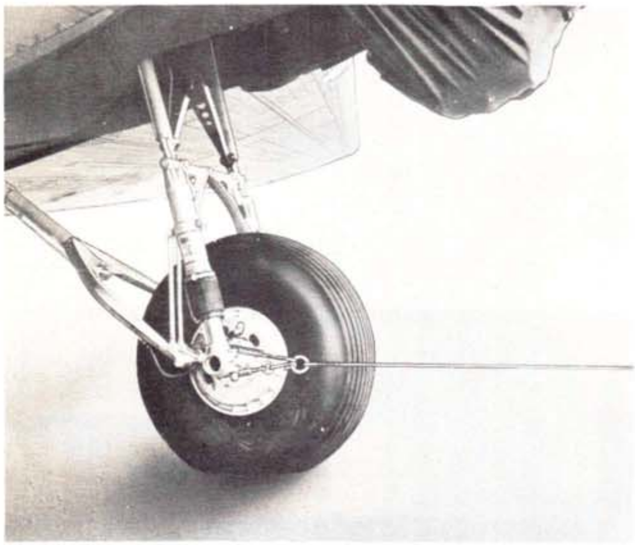


Figure 64—Attachment for Towing From Front

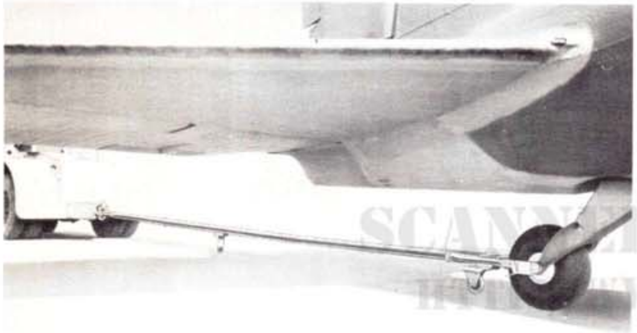


Figure 65—Tail Bow Bar in Use

arm dust excluders, and plug assemblies for exhaust stacks. Covers provided from AAF stock include propeller covers and wing covers.

(a) PROTECTIVE COVERS PROVIDED WITH AIRPLANE.—Information regarding the use and stowage of the protective covers listed above, which are furnished by the manufacturer with the airplane, is given in section IV, paragraph 16.*d.*(4), (6), (7), and (8).

(b) PROTECTIVE COVERS AVAILABLE FROM AAF STOCK.

1. PROPELLER COVERS.—Propeller blade covers should be installed whenever the propellers might be damaged, either as a result of handling in cold weather, or under any other condition when the propellers might be damaged during parking or storage of the airplane. The covers may be drawn from AAF stock.

2. WING COVERS.—When this airplane is parked in locations where frost is anticipated, canvas wing covers, furnished from AAF stock, should be installed. Their purpose is to protect the wings from frost so that a safe take-off may be made without first cleaning the wings.

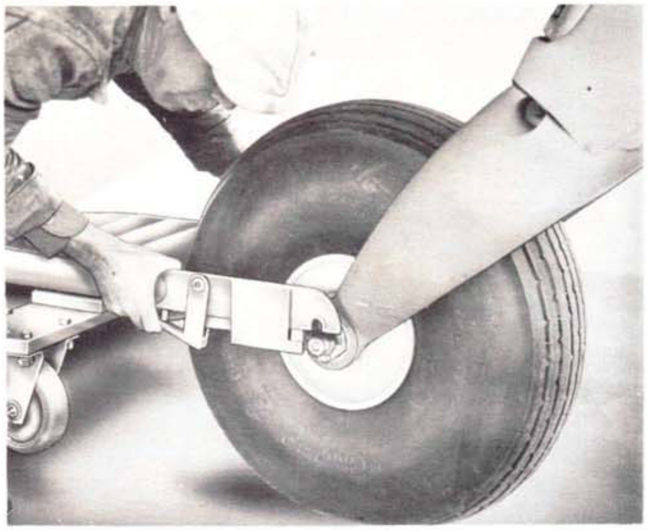


Figure 66—Attaching Tow Bar to Wheel Axle

WARNING

Do not attempt take-off with this airplane if the wings are covered with frost or ice. First remove the frost or ice.

Wing covers for the airplane may be obtained from AAF stock by requisitioning as follows: C-47 airplane tailored paulin, 03-F AAF Stock, stock No. 4500-635295, part No. CC47.

d. TOWING INSTRUCTIONS.—This airplane is towed from the front by attaching towlines to the main wheel axles, as shown in figure 63. Towing from the tail is accomplished by attaching a towbar (figure 64) to the rear wheel axle. The towbar hooks over towing lugs which protrude from either end of the axle, as shown in figure 65. During the towing operation there should always be one man in the pilots' compartment to operate the brakes, and a man at either wing tip when towing is near hangars, airplanes, or other obstacles. When towing either from the front or the rear, the tail wheel must be in "UNLOCKED" position. The airplane must never be moved by pushing or pulling on the control surfaces, stabilizers, tabs or flaps, but only by applying force to the wheel axle or to other approved locations. The following precautions should also be observed in towing, under the conditions set forth:

(1) Do not attempt to tow the airplane when the parking brakes are set.

(2) Do not attempt to tow the airplane over rough ground.

(3) A suitable double-acting spring and friction shock absorber, if available, should be used in all towing operation. (A shock absorber is an integral unit of the tail towbar shown in figure 65.)

(4) In starting, when towing from the front, the acute angle between the center line of the airplane and the line of the towing force must not exceed 60 degrees.

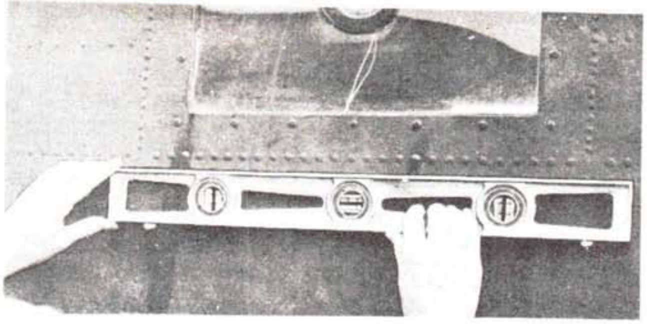


Figure 67—Leveling Airplane From Nose to Tail

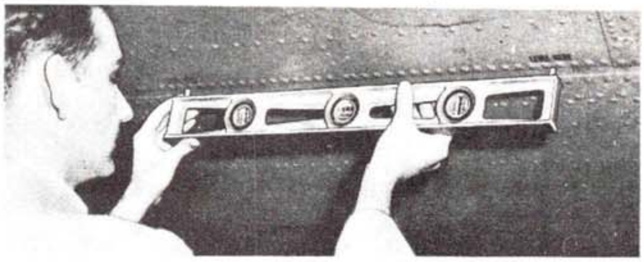


Figure 68—Leveling Airplane From Wing Tip to Wing Tip

(5) When towing from the tail, the acute angle between the tail wheel and the center line of the airplane must not exceed 60 degrees at any time; and in starting, this angle must not exceed 45 degrees.

(6) *Do not attempt to push the airplane forward by the tail wheel towbar.*

(7) Towing from the tail must never be attempted up a grade steeper than 11 percent (on hard ground). Towing from the tail on soft, boggy, or rough ground should be avoided.

(8) If the airplane is loaded, or being moved over soft ground, it must be towed from the front.

(9) Use low speed in towing from either front or tail; avoid sudden stops, particularly when towing from the tail.

(10) Never attempt to tow by a rope, or ropes from the tail wheel. Use a tail wheel towbar.

(11) Do not attempt to tow this airplane by the glider tow ring at the tail.

e. LEVELING PROVISIONS.—Two sets of leveling pins are provided as reference markers so that the airplane can be leveled on both longitudinal and lateral axes. Leveling is required before weighing the airplane to determine its basic weight and the location of its center of gravity.

Leveling is accomplished by placing a sensitive type spirit level against the reference pins and adjusting the airplane until it is level. Figure 67 shows a mechanic using a spirit level and a set of reference pins to level the airplane from nose to tail. The two leveling pins, shown in figure 67, are located outside the fuselage below the sixth cabin window. Figure 68 shows a mechanic leveling the airplane from wing tip to wing tip. The two leveling pins, shown in figure 68, are located on the bottom of the center wing section toward the forward edge, on the port side. If a spirit level with sufficient length to span the pins is not available, a straightedge with sufficient length may be used with the spirit level. Where considerable leveling (and weighing) is to be done, an inclined ramp may be constructed for the tail wheel. Hoisting of the tail is not necessary in leveling the airplane longitudinally where such a ramp is used. If a tail ramp is not available, a tail hoist is required; an attempt must not be made to jack the tail to level position. Lateral leveling (leveling from wing tip to wing tip) is accomplished by manipulating air pressure in the main landing-gear shock struts.

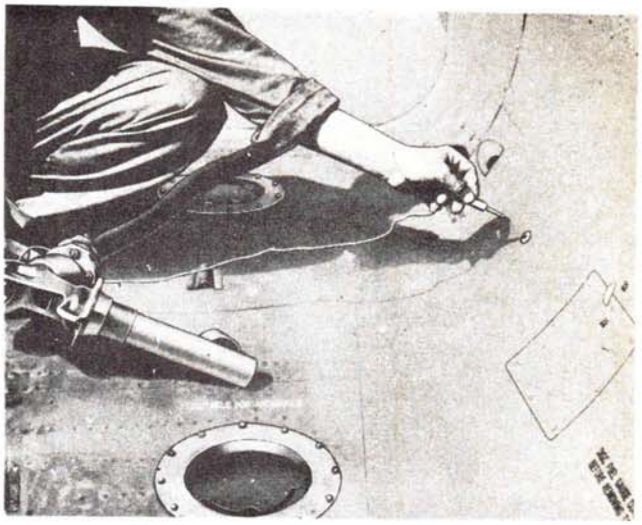


Figure 69—Bonding Fuel Discharge Nozzle to Airplane

3. SERVICING INSTRUCTIONS.

a. WALKWAYS.—The center wing section between the nacelles and the fuselage is reenforced for walkway purposes. When it is necessary to walk on the outer wing panels or on top of the fuselage, padded board should first be laid down.

b. SERVICING WITH FUEL.

(1) GENERAL PRECAUTIONS.

(a) NO FUEL SERVICING IN HANGARS.—Because of the hazards involved in handling fuel, all fueling operations, including both filling and draining, must be accomplished outside the hangar.

CAUTION

Under any circumstances, do not put fuel in this airplane or drain fuel from this airplane *except when it is outside the hangar, and at a safe distance from other buildings and other aircraft.*

(b) BONDING FUEL DISCHARGE NOZZLE TO AIRPLANE.—The fuel delivery hose must be metal lined or otherwise bonded between the nozzle and the

fittings on the opposite end. One end of a flexible bonding wire must be permanently attached to the discharge nozzle. When a fuel tank is to be filled, the free end of this bonding wire will be attached to the uninsulated metallic part of the airplane to assure an electric bond between the tank and the delivery hose. Do not attach the bonding wire adjacent to the filler neck of the tank. This bond must always be made before removing the filler cap of the tank to be filled and must not be disconnected until the cap has been replaced.

1. INSTALLING FUEL NOZZLE GROUNDING RECEPTACLE.—On all C-47A and on early C-47B airplanes a grounding plug (AN2553) must be installed on each side of the fuselage, on the upper surface of the center wing. The location in both cases must be within 4 feet of the two filler caps and should be near a frame. On later C-47B airplanes a Mallory B111745X receptacle is installed. (Figure 69.)

(c) FUEL TRUCK MUST BE GROUNDED.—When a fuel truck is employed in any fueling operation in connection with this airplane, the truck must be equipped with a static ground chain.

(2) NUMBER OF FUEL TANKS.—This airplane has four regular fuel tanks, consisting of two main tanks and two auxiliary tanks; and may also be equipped with two, four, six, or eight long-range tanks. For a complete description of fuel tanks and the fuel system, refer to section IV, paragraph 10.

(3) LOCATION OF FUEL TANKS.—The two main tanks are located in a forward position in the center wing section. The auxiliary tanks are also located in the center wing section, one aft of each main tank. Cylindrical shaped long-range tanks are carried in the cargo compartment. If only two long-range tanks are carried, they are located lengthwise in the forward position, aft of the compartment bulkhead. If four long-range tanks are carried, two are located lengthwise aft of the forward pair. (In some airplanes the front two or four long-range tanks are carried in tiers two deep, on the right side of the fuselage, leaving room on the left side for glider tow equipment.) Six or eight tanks are placed lengthwise on the floor in pairs.

(4) CAPACITY OF FUEL TANKS.—Main (forward) tanks have 202 U.S. (168.3 Imperial) gallons each, or a total of 404 U.S. (336.5 Imperial) gallons. Auxiliary (aft) tanks: 200 U.S. (167 Imperial) gallons each, or a total of 400 U.S. (333 Imperial) gallons. Long-range tanks: 100 U.S. (83 Imperial) gallons each, or a total capacity (eight tanks) of 800 U.S. (666 Imperial) gallons.

(5) KIND OF FUEL USED.—To obtain full rated horsepower of the engines, 100/130 grade fuel, Specification No. AN-F-48, must be used.

(6) HOW FUEL TANKS ARE FILLED.

(a) FILLING AUXILIARY AND MAIN FUEL TANKS.—The auxiliary tanks should be filled first in order to prevent siphoning action from the main tanks to the auxiliaries, which will result if the mains are filled first. If only 400 U.S. (333 Imperial) gallons of fuel are carried, it will be carried in the auxiliary tanks.

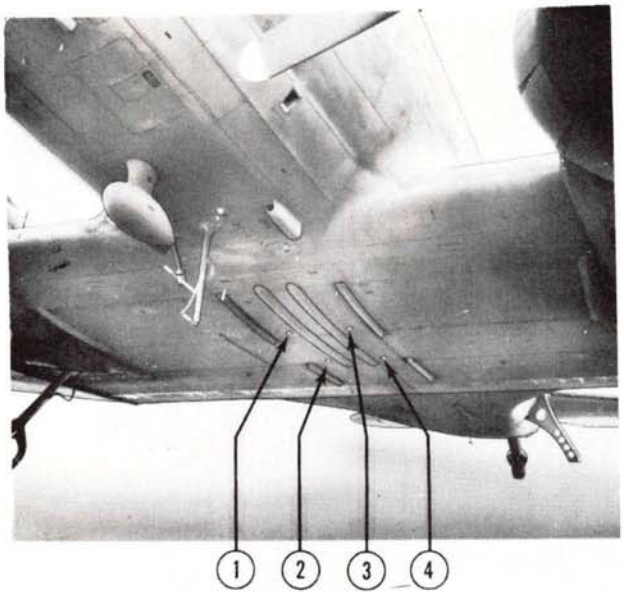


Figure 70—Fuel Tank Drain Points

1. Right Main Fuel Tank
2. Right Auxiliary Fuel Tank
3. Left Main Fuel Tank
4. Left Auxiliary Fuel Tank

Note

Fill the auxiliary tanks with fuel before any fuel is put into the main tanks.

The two auxiliary tanks are filled at two filler necks located in the upper surfaces of the center wing section. The filler caps are accessible without removing cover plates. (See figure 7.)

Note

To avoid damage to filler necks in tanks, the delivery hose must be held by personnel and must not be allowed to remain in the tank without support.

The two main tanks are always filled *after* the auxiliary tanks have been filled. The filler necks of the main tanks are accessible without removing cover plates on the upper surface of the center wing.

(b) FILLING LONG-RANGE FUEL TANKS.—The long-range tanks are filled at the filler openings on the forward tanks. If two or four tanks are installed on the fuselage floor, they may be filled to capacity at either of the two forward tanks. If four tanks are installed on the right side in tiers of two (as in glider tow equipped airplanes), they will fill to capacity by filling the upper forward tank; *however, the cross-feed valve, located aft of the door to the companionway, must be*

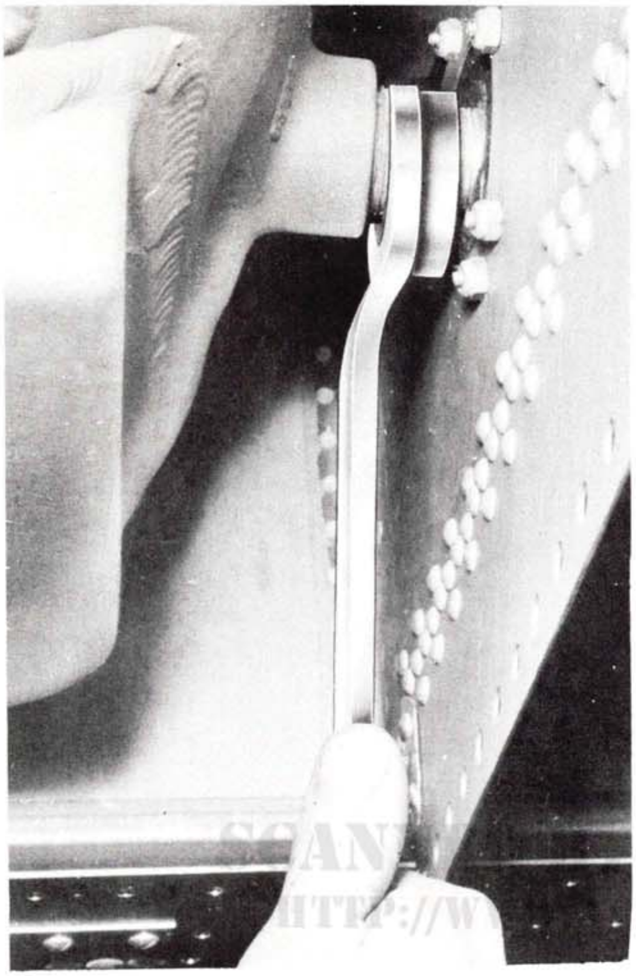


Figure 71—Fuel Tank Sump Drain Wrench in Operation

open or the two bottom tanks will not fill. If six tanks are installed (four tanks on the fuselage floor and two tanks over the forward two tanks), the system can be filled to capacity at either upper forward tank; however, in this case also, *the cross-feed valve aft of the companionway must be open,* otherwise it will be necessary to fill to capacity at *both* upper forward tanks. If eight tanks are installed (lying in pairs on the floor of the fuselage), the system may be filled at either forward tank; however, the cross-feed valve aft of the companionway must be open, otherwise the filling must be made at both forward tanks.

(7) DRAINING FUEL TANK SUMPS.—In various ways (mostly by condensation or sweating), small quantities of water get into the fuel tanks. Being heavier than fuel, the water seeks a lower level in the tanks. This is tapped by opening drain cocks at the bottoms of the sumps, which are located on the under side of the center wing, under the fuselage. (See figure 70.) These cocks, which are safetied with wire, should be opened every time the tanks are filled and again at the end of each flight, so that the water can be drained out. When the cocks are closed, they must be resafetied. Much of the condensation or sweating, within fuel tanks, occurs soon after landing. Therefore, it is advisable to service with fuel as soon as practicable after the airplane has landed, thus preventing condensation of water vapor on the inside of the fuel tanks.

Note

When replacement of the main fuel tank sump adapter gasket is necessary, the gaskets should be fabricated of gasket material, Specification No. AN-C-32.

(a) REMOVING FUEL FROM MAIN AND AUXILIARY TANKS.—Fuel is removed from the main or auxiliary tanks by either of two methods: by draining from the four drain cocks located on the under surface of the center wing beneath the fuselage, as shown in figure 70, or by pumping through the filler neck of each tank. Pumping is usually more satisfactory because it is faster. If the fuel is to be removed from all four tanks (two auxiliaries and two mains), the fuel in the main (forward) tanks must be removed *first.*

(8) DRAINING WATER FROM LONG-RANGE FUEL TANKS.—Water is drained from the long-range fuel tanks *before each flight* by opening a needle valve (or valves) at the aft end of the tank system. Two- and four-tank installations have only one drain valve, while six- and eight-tank installations have two. The drain valves occupy the lowest position in the long-range fuel tank system.

Note

The fuselage will set on an incline after the airplane has landed. Because water is heavier than fuel, the water will collect in the plumbing adjacent to the drain valves.

The drain valves are always safetied with wire. After completing the job of draining, the valves must be closed tight and resafetied.

(a) DRAINING FUEL FROM LONG-RANGE TANKS.—Fuel is drained from the long-range tanks by opening the same needle valve (or valves) that are used in draining water from the tanks, as given above. Two- or four-tank installations are drained by one valve. A rubber hose leading from the drain valve to the door of the cargo compartment will provide a satisfactory conduit.

Note

Where four tanks are installed in tiers of two, on the right side of the fuselage, the cross-feed valve aft of the companionway must be opened, otherwise only two of the four tanks will be drained.

Six- or eight-tank installations should be drained by opening the drain valve at the lower end of each aft tank.

(9) FILLING FUEL TANK CORROSION-PREVENTIVE CARTRIDGES.—Located at the bottom of each main and auxiliary fuel tank sump is a plug-screw assembly containing the sump drain cocks (figure 70), and also containing a cartridge filled with potassium chromate crystals. These crystals prevent corrosion in the fuel tanks. The cartridge must be removed, cleaned, and refilled with potassium chromate crystals every 300 hours (every sixth 50-hour inspection). The plug-screw

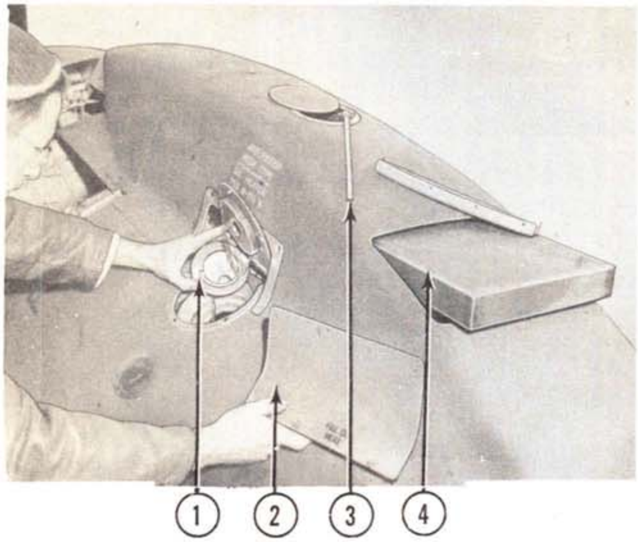


Figure 72—Preparations for Filling Oil Tank

1. Oil Tank Filler Cap
2. Oil Tank Access Cover Plate
3. Measuring Rod
4. Carburetor Air Filter

assemblies (37B4095-1, right and -2 left) are removed by a special tool—the gas tank sump drain wrench (K21601), as shown in figure 71. To service potassium chromate cartridges, proceed as follows:

(a) Drain or pump all fuel from the fuel tanks. (To drain fuel tanks refer to paragraph 3.*b*.(7)*(a)*, this section.)

(b) Remove the plug-screw assemblies from the tank sumps.

(c) Thoroughly clean the cartridges.

WARNING

Handle potassium chromate with care, both in cleaning and refilling. Potassium chromate is poisonous and inflammable.

(d) Refill the cartridges with a fresh supply of potassium chromate.

Note

Potassium chromate crystals are ordered as required from AAF stock; nomenclature, potassium chromate—purified crystal (No. 4 to 12 mesh size) class 19.

(e) Install plug-screw assemblies in fuel tank sumps.

(f) Refill fuel tanks.

(10) FUEL FILTERS.—Refueling units will be equipped with filters which will remove all solid particles having minor dimensions five microns or larger, and capable of removing 99.5% of all free water.

c. SERVICING WITH OIL.

(1) As a fire preventive measure, filling or draining of oil must be accomplished outside the hangar at a safe distance from other buildings and other aircraft.

CAUTION

Do not attempt to fill or drain oil from this airplane inside a hangar without obtaining specific authority from the station engineering officer. Occasionally such authority is granted where weather conditions make oil servicing outside the hangar inadvisable.

(2) FILLING WITH OIL.—This airplane has two oil tanks, one for each engine. Each tank is filled at its filler neck, accessible through handholes in the top of the nacelles. (See figures 7 and 72.) The capacity of each tank is 29 U.S. (24.1 Imperial) gallons; however, no more than approximately 25 U.S. (20.8 Imperial) gallons of oil are put into either tank at any one time. The excess tank space allows for oil expansion without oil waste. Each tank is equipped with an oil level stick for determining the minimum oil quantity.

Note

This airplane is equipped with hopper-type oil tanks. Therefore, the engine lubricating oil should be drained only at engine change, unless some unusual circumstance, such as failure of an engine part, makes it advisable to change the oil before that time.

(3) DELETED.

Table III lists the three grades of oil in general use with recommended operating temperature ranges.

TABLE III

Grade Oil	*Air Temperature at Ground*	*Safe Maximum "Oil-In" Temperature*	*Safe Minimum "Oil-In" Temperature*
1120	4°C (40°F) and above	95°C (203°F)	20°C (68°F)
1100	−7° to + 27°C (20° to 80°F)	85°C (185°F)	10°C (50°F)
1080	10°C (50°F) and below	75°C (167°F)	0°C (32°F)

Note

By employing the oil dilution system to facilitate starting in cold weather, the airplane can be operated in most temperature conditions with grade 1120 oil. However, grade 1100 oil may be used at the discretion of the engineering officer with ground temperatures below 4°C (40°F). Oil lighter than grade 1100 should not be required when using the oil dilution system.

(4) DRAINING OIL SUMP AND Y-DRAIN.—Prior to engine starting, the oil tank sump drains and Y-drains should be opened and checked for water, ice, or congealed oil. The sump drains (figure 73) are located at the bottom of the oil coolers. The Y-drains (figure 74) are located on the forward side of the fire wall, near the bottom and toward the outboard side. If water is present, it will drain from these points. If ice or congealed oil is present, which may be indicated by no flow, a "heat gun" or other type of heater without an open flame may be used for thawing. Close the drain as soon as the water is drained, or as soon as normal oil flow begins. Oil tank sump drains and Y-drains must also be drained of condensate immediately after every flight. Be sure that these drains are closed after each draining or inspection.

d. SERVICING HYDRAULIC SYSTEM WITH FLUID. *(See figure 75.)*—Complete instructions for servicing the hydraulic system with fluid are given in section IV, paragraph 13.*b.*(1)*(a).*

e. SERVICING ANTI-ICER SYSTEMS WITH FLUID. *(See figure 75.)*—Complete instructions for servicing the anti-icer systems with fluid are given in section IV, paragraph 19.

f. SERVICING STEAM HEATING SYSTEM. *(See figure 75.)*—Complete instructions for servicing the steam heating system are given in section IV, paragraph 18.*a.*

g. SERVICING BATTERIES WITH WATER. *(See figure 75.)*—Complete instructions for servicing the batteries with water are given in section IV, paragraph 14.*b.*(3)*(b)3.* and *4.*

h. SERVICING SHOCK STRUTS WITH FLUID AND AIR. *(See figure 75.)*—Complete instructions for servicing shock struts with fluid and air are given in section IV, paragraph 13.*c.*(4).

i. SERVICING TIRES. *(See figure 75.)*—Complete instructions for servicing tires are given in section IV, paragraph 4.*b.*(7)*(a).*

j. SERVICING FIRE EXTINGUISHING EQUIPMENT. *(See figure 75.)*—Complete instructions for servicing fire extinguishing equipment are given in section IV, paragraph 17.*b.*(3)*(b).*

k. SERVICING (FILLING) OXYGEN TANKS AND PORTABLE CYLINDERS. *(See figure 75.)*—

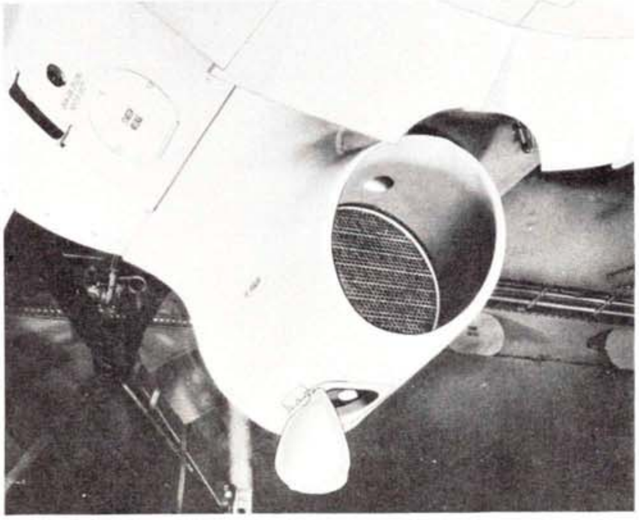


Figure 73—Oil Cooler Drain Plug

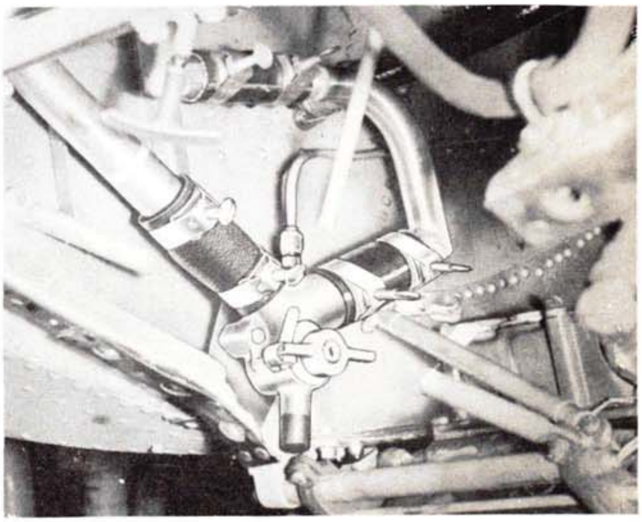


Figure 74—Oil System "Y" Drain Cock on Fire Wall

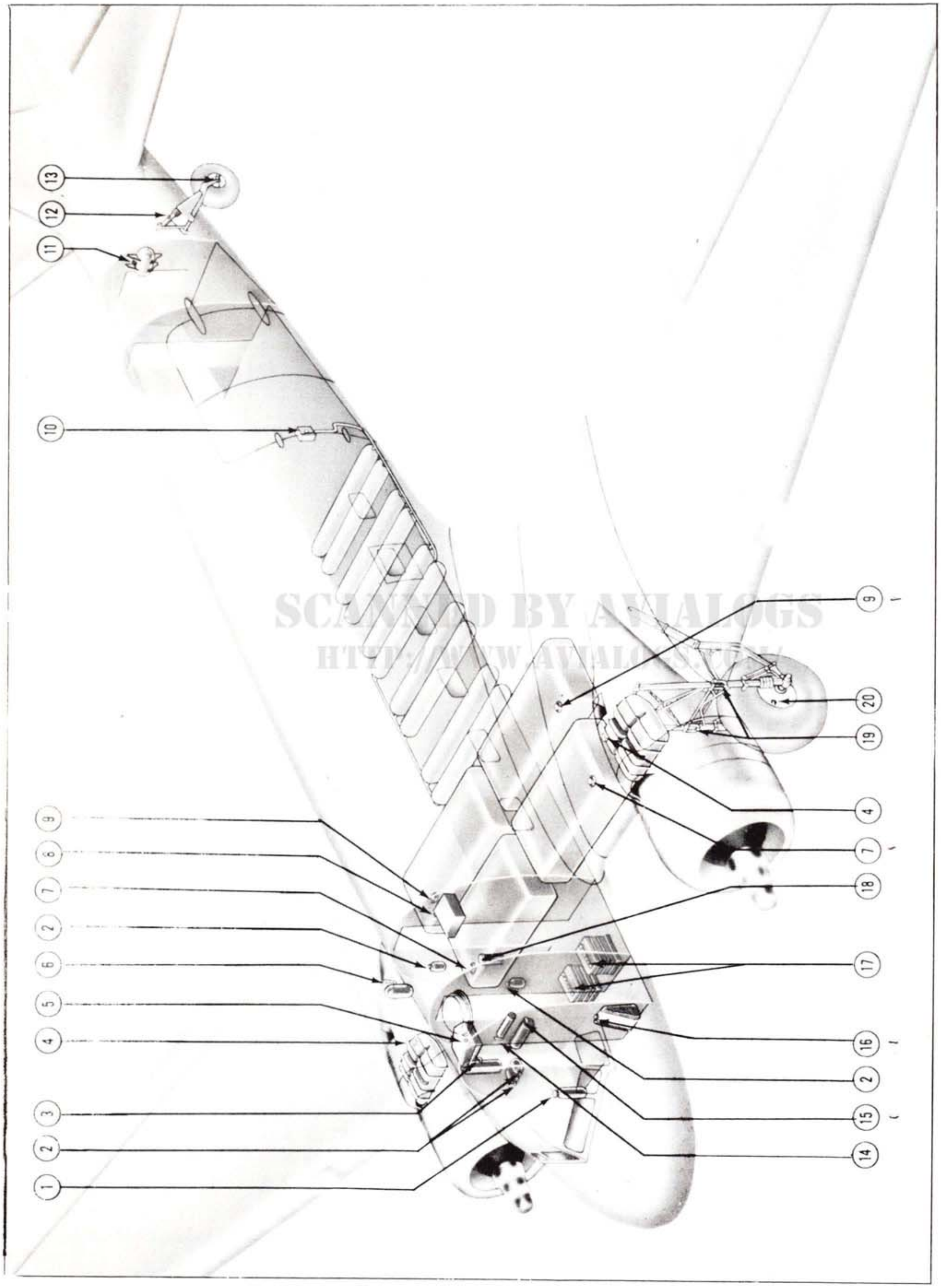

1
2
3
4
5
6
2
7
8
9
10
11
12
13
14
15
2
16
17
18
7
4
19
20
9

Figure 75—Replenishment Chart

KEY TO FIGURE 75

1. Fire Extinguisher
2. Oxygen (Portable Cylinders)
3. Hydraulic Fluid Reservoir
4. Oil Tanks
5. Anti-Icing Fluid
6. Steam Heating System
7. Main Fuel Tanks
8. Drinking Water
9. Auxiliary Fuel Tanks
10. Oxygen System
11. Lavatory Water Supply
12. Tail Gear Shock Strut
13. Tail Gear Tire
14. Portable Fire Extinguisher
15. Anti-Icing Fluid
16. Anti-Icing Fluid
17. Batteries
18. Steam Heating System
19. Main Landing-Gear Shock Struts
20. Main Landing-Gear Tires

Complete instructions for filling oxygen tanks and portable cylinders are given in section IV, paragraph 20.*c*.(2).

4. LUBRICATION REQUIREMENTS.

a. GENERAL.—Proper lubrication is of vital importance to the operation and continued service of this airplane. Figure 84 located at the end of paragraph 4, gives lubrication requirements for every 25 hours, 50 hours, 100 hours, or longer, of service under all climatic conditions. Corresponding Navy periods are 30, 60, and 120 hours.

b. HOW LUBRICANTS ARE APPLIED.—Where oil is specified, it should be applied by a controllable squirt can. A grease gun is used on all zerk fittings; in other cases where grease is specified, it may be applied in any convenient manner. A small paint brush is handy in applying graphite base grease.

c. LUBRICATION OF BEARINGS.

(1) LUBRICATION OF SEALED BEARINGS.—Sealed bearings (used in almost all pulleys and in many other moving connections where excessive wear is expected) have the grease sealed in and do not ordinarily require additional lubrication. Bearings in locations exposed to the air stream and primary control surface bearings, however, may lose grease and require relubrication.

Note

> Do not subject sealed bearings to excessive amounts of cleaning solvents. Solvents will seep through the seals and remove the grease within. Wiping or cleaning the outside of a sealed bearing with a solvent moistened rag is permissible, but care should be taken not to saturate the bearing. GASOLINE WILL NOT BE USED TO CLEAN BEARINGS. Instead, use solvent, Federal Specification No. P-S-661, or kerosene, Federal Specification No. VV-K-211. Sealed bearings are to be relubricated, *only when field conditions make it absolutely necessary*, with grease, Specification No. MIL-G-3278, by the use of AAF tool No. 37B5054, Alemite tool No. 6212, or a similar purpose tool.

(2) LUBRICATION OF OPEN-TYPE BEARINGS.—Unlike sealed bearings, open-type bearings require cleaning and repacking at regular intervals. (Figure 76 illustrates cleaning and repacking a main wheel bearing, which is typical for any open-type bearing.) In cleaning this type of bearing, be sure to remove all old grease with solvent, Federal Specification No. P-S-661, or kerosene, Federal Specification No. VV-K-211. Where equipment is not available to repack bearings under pressure, grease should be thoroughly worked into the bearing races and around the rollers with the palm of the hand until the grease can be seen coming out on the other side. Smearing the grease on the outside of the rollers will not lubricate the inner bearing races and may cause freezing or failure of the bearing.

d. PROPER LUBRICATION FOR CLIMATIC REQUIREMENTS.—Lubrication requirements will vary considerably under various climatic conditions. For example, summer requirements are different from winter requirements, and requirements in dry, dusty areas must be modified to fit salt air climates. Climatic conditions must not be ignored in the lubrication of this airplane.

(1) TEMPERATURE CONSIDERATIONS.

(a) Main and tail landing gear wheel bearings should be lubricated with grease, high temperature lubricating, Specification No. MIL-L-3545.

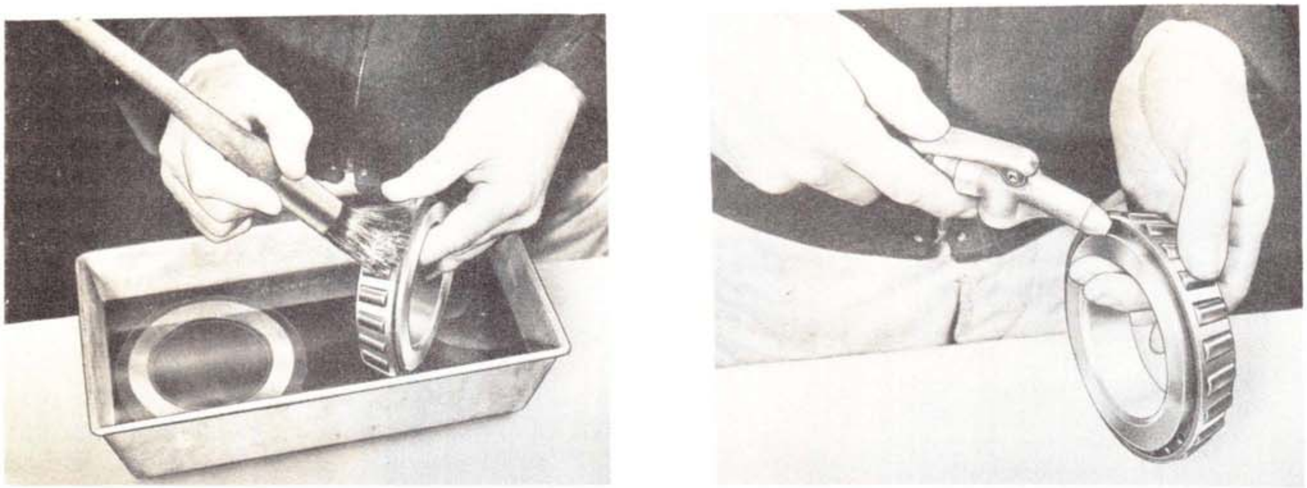
(b) For general squirt-can lubrication, summer and winter, use Specification No. AN-O-6 oil.

(c) Exhaust manifold mounting bracket parts subject to high temperature and limited motion will be hand-lubricated with anti-seize compound, Specification No. MIL-C-5544.

(2) DUST AND SALT AIR CLIMATES.

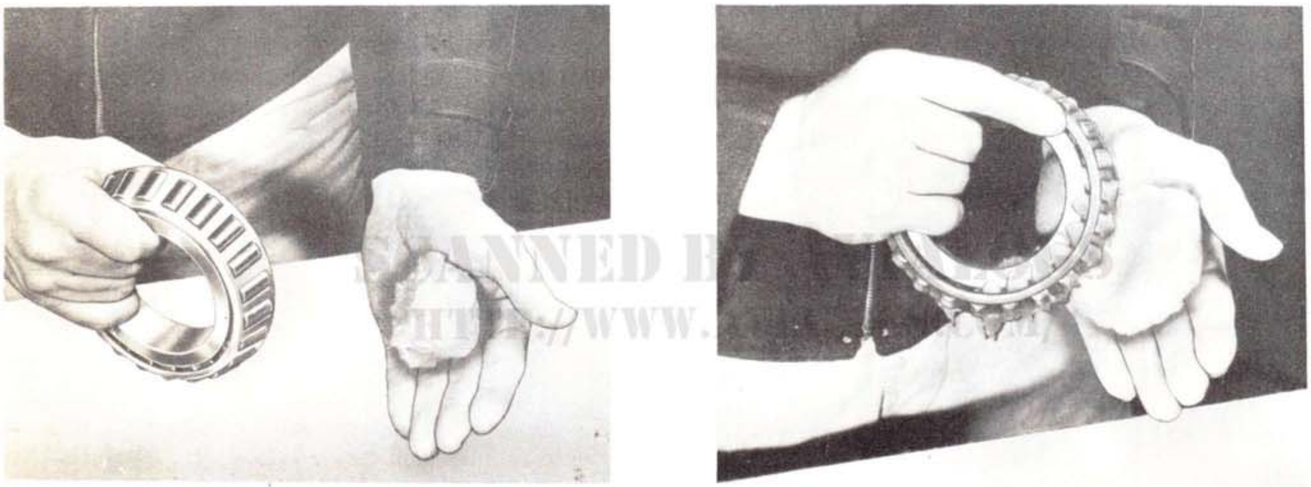
(a) Dust, dirt, or sand combines with grease, oil or graphite to form a grinding compound. Therefore, it is important to remove excess lubricants from all moving parts subject to extreme dust conditions. Inspect all points to be lubricated carefully and frequently and do not neglect lubrication. In desert operation, force out such dirt as may work into internal grease fittings by *cutting lubrication period in half.*

(b) Control cable sections running over pulleys, on drums, or through fair-leads should be inspected every 50/60 hours for wear of anticorrosion coating and touched up, if necessary, with compound, Specification No. MIL-C-6708, type I.



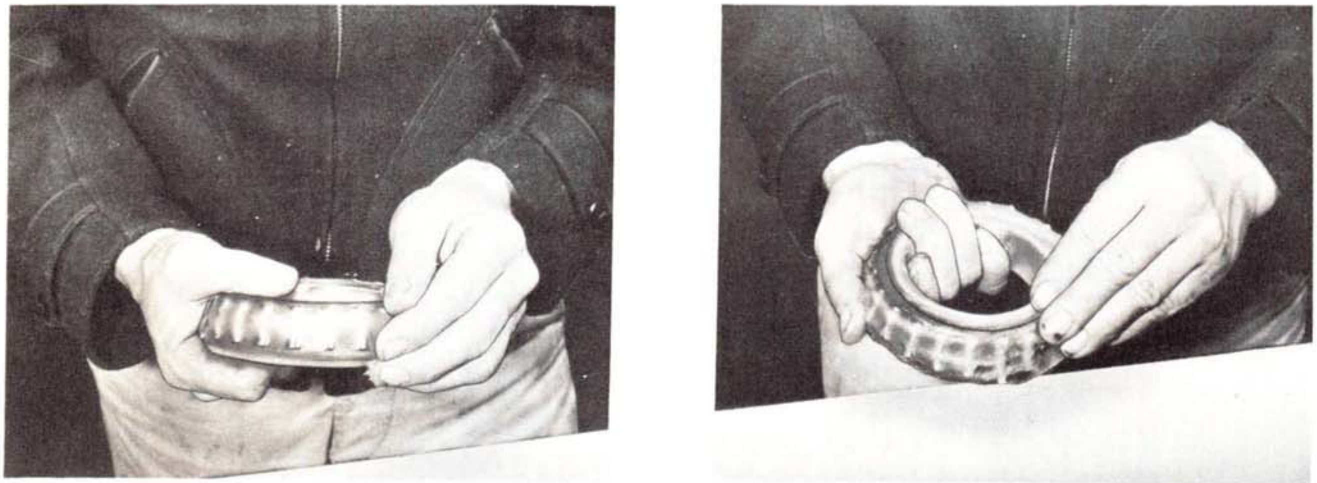
Cleaning Bearing with Solvent and Brush

Drying Bearing with Air Pressure



Lubricant Before Application

Forcing Lubricant Through Internal Races



Working Lubricant Into Rollers

Working Lubricant Into Roller Races

Figure 76—Lubricating Open-Type Bearing

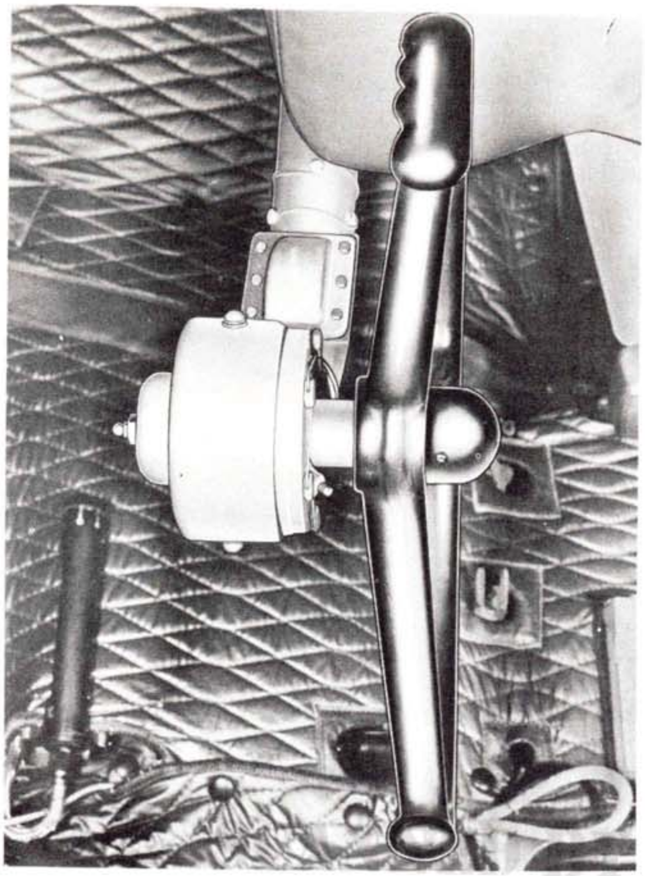


Figure 77—Control Wheel Column—Showing Lubrication Fitting

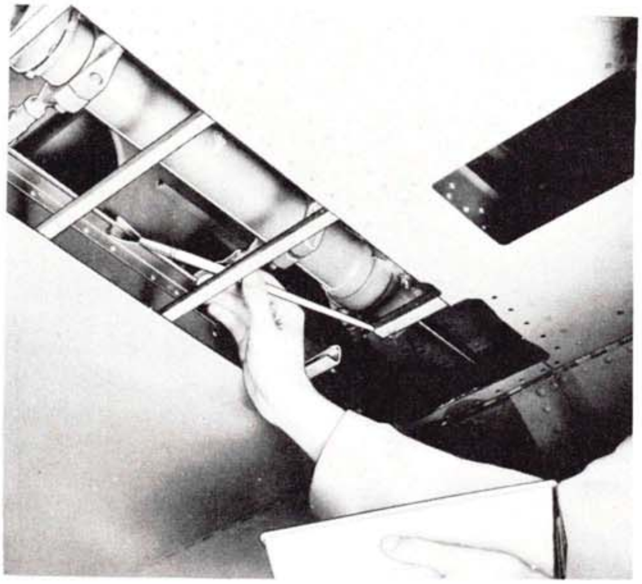


Figure 78—Applying Lubricant to Wing Flaps Actuating Cylinder Roller Tracks

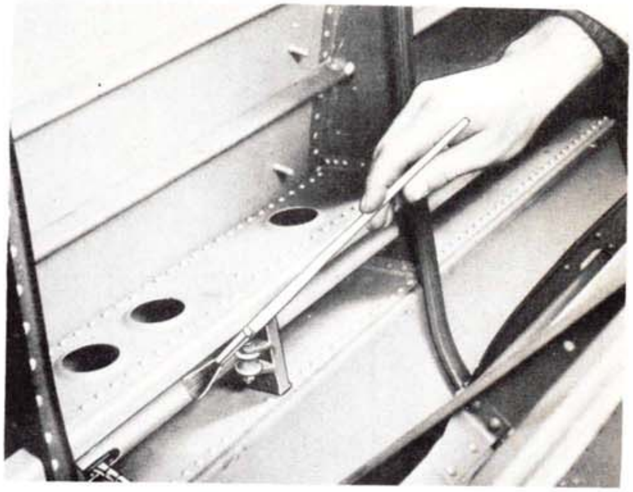


Figure 79—Applying Lubricant to Wing Flaps Actuating Rod

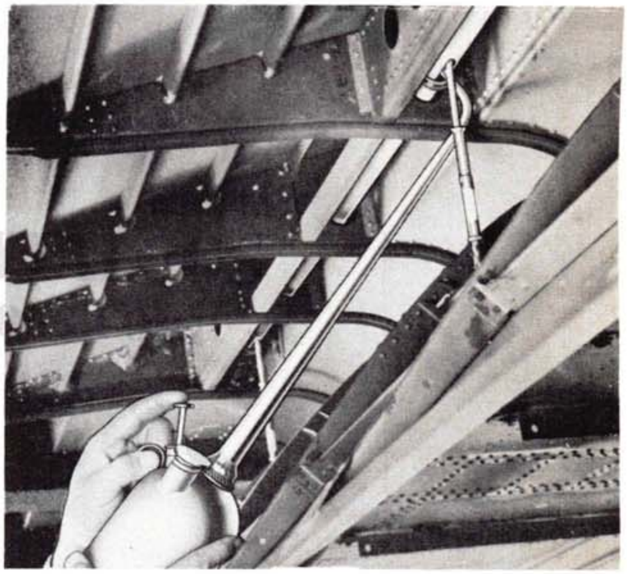


Figure 80—Application of Lubricant to Wing Flaps Actuating Rod Universal Joint

(c) LUBRICATION IN SALT AIR CLIMATES.

1. Lubrication requirements under salt air conditions are the reverse of requirements in dry, dusty climates. Plentiful use of oil, grease, and rust preventative will help to prevent corrosion.

2. Service all landing-gear fittings immediately after exposure to extremes of wet or salty atmosphere.

e. MISCELLANEOUS LUBRICATION REQUIREMENTS.

(1) The specialized lubricating requirements of engines, instruments, and accessories are not covered by figure 84. For such lubrication, existing orders should be followed.

(2) Lubricate surface control system activating and adjusting screws and trim tab actuating screws and nuts **by hand with grease, Specification No. MIL-G-7118, as operating conditions warrant.**

(3) For treatment of air filters, use three parts **of engine oil, Specification No. MIL-O-6082 to one**

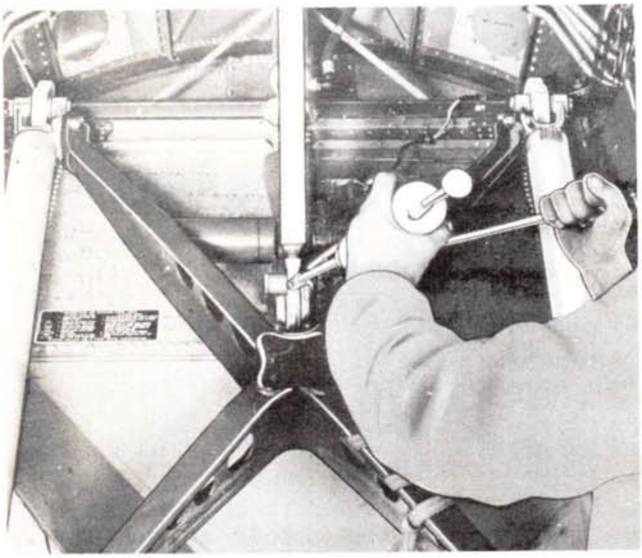


Figure 81—Application of Lubricant to Landing-Gear Actuating Cylinder Piston Rod Hook

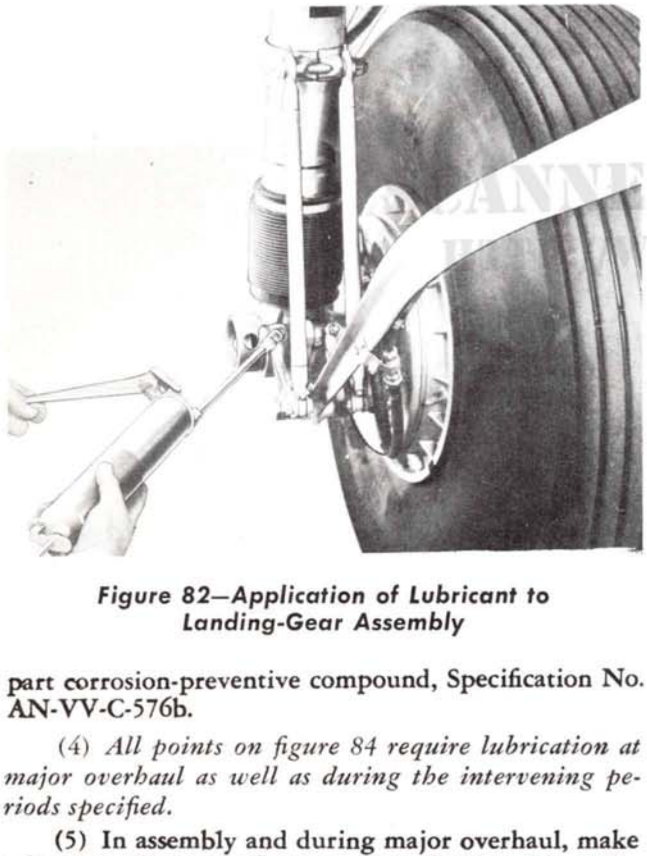


Figure 82—Application of Lubricant to Landing-Gear Assembly

part corrosion-preventive compound, Specification No. AN-VV-C-576b.

(4) *All points on figure 84 require lubrication at major overhaul as well as during the intervening periods specified.*

(5) In assembly and during major overhaul, make a hand application of grease, Specification No. MIL-G-3278, instead of the specified oil applications on all parts where a frequency symbol is followed by an asterisk(*). (See figure 84.) Thus, at the specified service intervals, asterisk items are to be oiled, not greased; at major overhaul, they are to be greased not oiled.

f. LUBRICATION APPLICATIONS.—The charts in figure 84 illustrate the application of lubricants to various parts of the airplane where the lubrication fittings or locations are in difficult or awkward places.

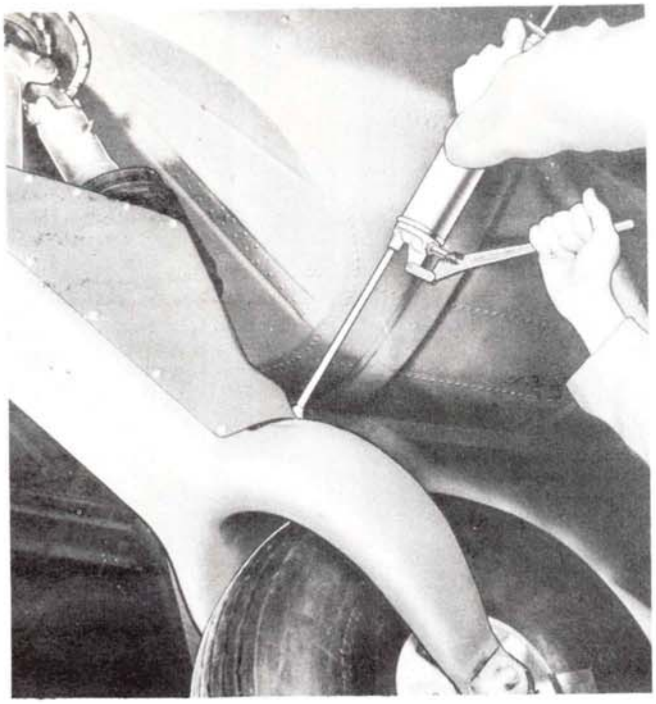


Figure 83—Application of Lubricant to Tail Wheel Gear —Lower Shock Strut Fitting Being Serviced

5. SPECIAL TOOLS AND EQUIPMENT.

a. GENERAL.

(1) This paragraph concerns the special service tools and ground handling equipment designed for the C-47 series airplane. These tools are available by requisition through channels from supply depots in the continental United States and overseas.

(2) First and second echelon tools are stocked as a kit assembly, operational squadron tool, under part No. K36201, and are issued on the basis of one per five aircraft. Third echelon tools are stocked as a kit assembly, service squadron tool, under part No. K36401, and are issued on the basis of one per 10 aircraft. Fourth echelon tools are stocked as a kit assembly, major overhaul tool, under part No. K36601, and are issued on the basis of one per 25 aircraft.

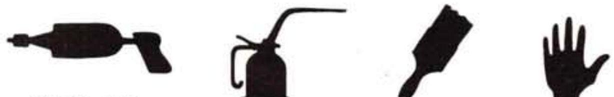
(3) The illustrations of these tools, in the following pages, have been divided into two groups, ie, ground handling equipment and special service tools.

(4) The illustrations contain sufficient information to enable personnel to manufacture the tools locally.

(5) Illustrations showing the application of these tools appear in this handbook under the sections or paragraphs pertinent to the part of the airplane or the equipment concerned, and will refer the reader to this paragraph for manufacturing information.

(6) Engine service tools are listed in paragraph 5.*d.* of this section.

APPLICATION SYMBOLS



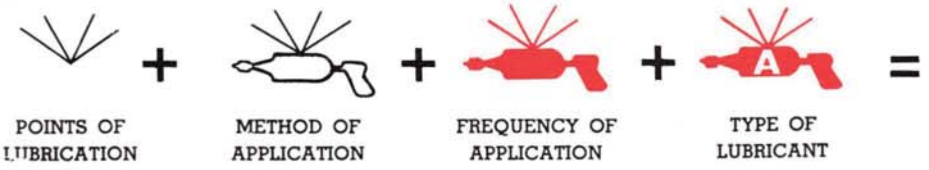
FREQUENCY SYMBOLS

🟥	🟨	🟩	🟪
RED *EVERY* *25/30 HRS*	YELLOW *EVERY* *50/60 HRS*	GREEN *EVERY* *100/120 HRS*	PURPLE *FREQUENCY* *OVER 100/120 HRS*

TABLE OF LUBRICANTS

IDENTIFICATION	BASE SPECIFICATION	TYPE OF LUBRICANT	TEMP. RANGE (AMBIENT/AIR T.)°F.	USES (HEREIN)
A	AN-G-25	Grease, Low Temperature Lubricating (Low Volatility Type)	—65 to +250	Antifriction bearings, activators, and working joints of the doors where low temperature is expected and high torque is not available.
B	AN-G-15	Grease, General Purpose, Aircraft Lubrication	—40 to +250	Wheel bearings and support members.
C	3607	Grease, Lubricating, Graphite	—40 to +160	Places where frequent lubrication is not possible and where graphite will lubricate in case all other lubricant is lost.
D	AN-O-6a	Oil, Lub. (Light)	—67 to +160	General squirt can lubrication.
E	2-120 (AXS-777)	Oil, Lubricating Preservative, Special	—65 to +160	For Moderate Low and Extreme Low Temperature "Squirt Can."
F		Graphited Oil (Mixture of 1 lb. AN-G-24 per gallon Spec. AN-O-6a)	—50 to +250	Exposed Hinge and Pin Joint Lubrication.
H	AN-G-24	Graphite, Lubricating		Graphite Lubrication for sliding surfaces and general "residual" type lubrication.
I	AN-C-147	Compound, Anti-Seize Graphite Petrolatum		Surfaces subjected to high temperatures and limited motion. (Exhaust Manifold Brackets, etc.)
J	AN-G-10	Grease, Extreme Pressure, Low Temperature, Lubricating	—65 to +160	Control Surfaces Operating Mechanisms. (Flap Gear Box, Tabs, etc.)
Z	AN-C-52 Type I	Corrosion Preventive Exterior Surface		Cable coating as corrosion preventive.

EXAMPLE OF CODING



Indicated points lubricated with Zerk or Alemite gun every 25 hours using type "A" lubricant AN-G-25. (See above table of lubricants.)

* AN-G-25 GREASE DURING MAJOR OVERHAUL

Figure 84—Lubrication Chart (Sheet 1 of 5 Sheets)

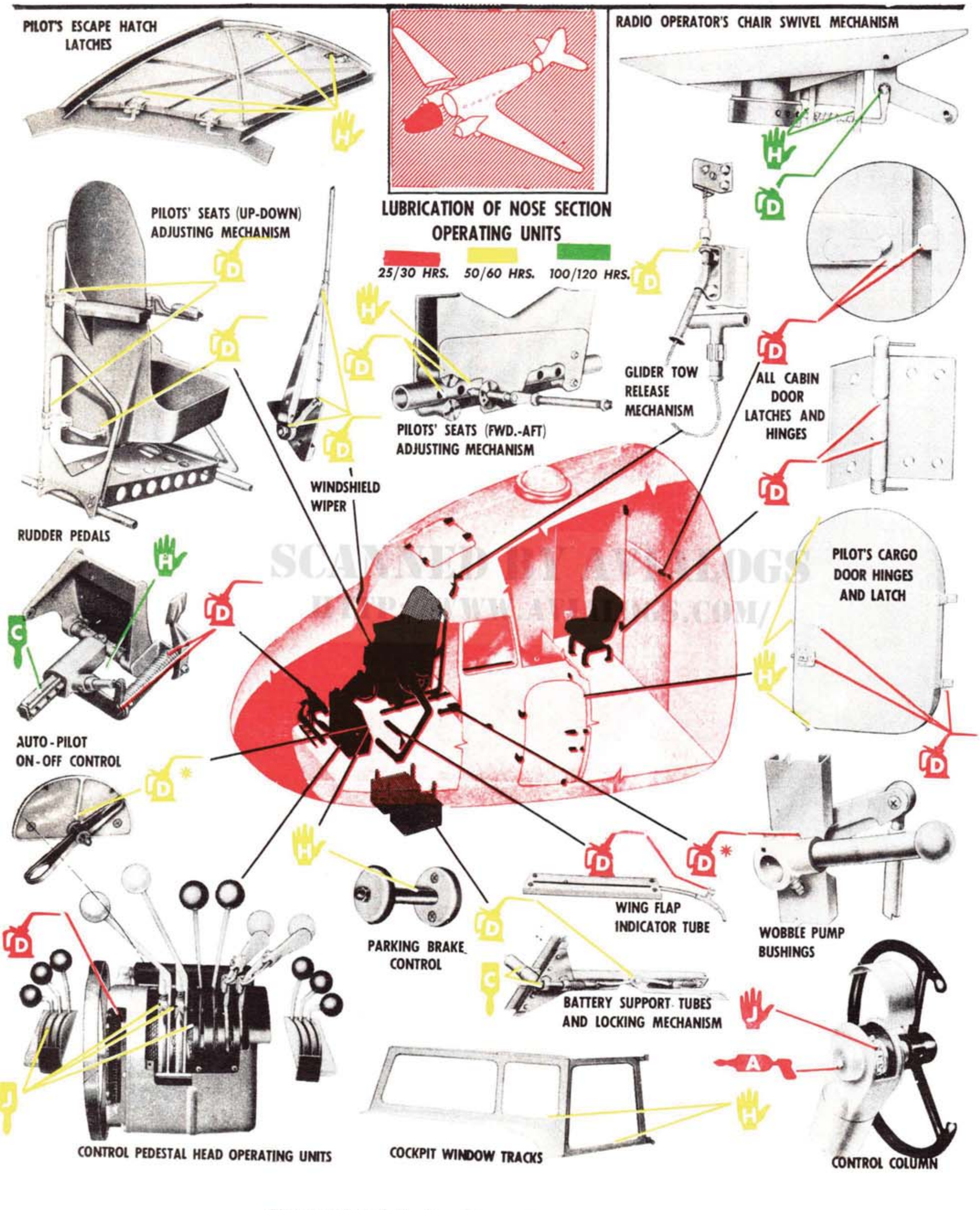

PILOT'S ESCAPE HATCH LATCHES
H
RADIO OPERATOR'S CHAIR SWIVEL MECHANISM
H
D
LUBRICATION OF NOSE SECTION OPERATING UNITS
🟥 25/30 HRS.
🟨 50/60 HRS.
🟩 100/120 HRS.
PILOTS' SEATS (UP-DOWN) ADJUSTING MECHANISM
D
D
H
D
D
D
PILOTS' SEATS (FWD.-AFT) ADJUSTING MECHANISM
WINDSHIELD WIPER
GLIDER TOW RELEASE MECHANISM
D
ALL CABIN DOOR LATCHES AND HINGES
D
D
RUDDER PEDALS
H
C
D
PILOT'S CARGO DOOR HINGES AND LATCH
H
D
AUTO-PILOT ON-OFF CONTROL
D *
H
D
D *
PARKING BRAKE CONTROL
WING FLAP INDICATOR TUBE
WOBBLE PUMP BUSHINGS
D
D
C
BATTERY SUPPORT TUBES AND LOCKING MECHANISM
J
A
J
H
CONTROL PEDESTAL HEAD OPERATING UNITS
COCKPIT WINDOW TRACKS
CONTROL COLUMN

Figure 84—Lubrication Chart (Sheet 2 of 5 Sheets)

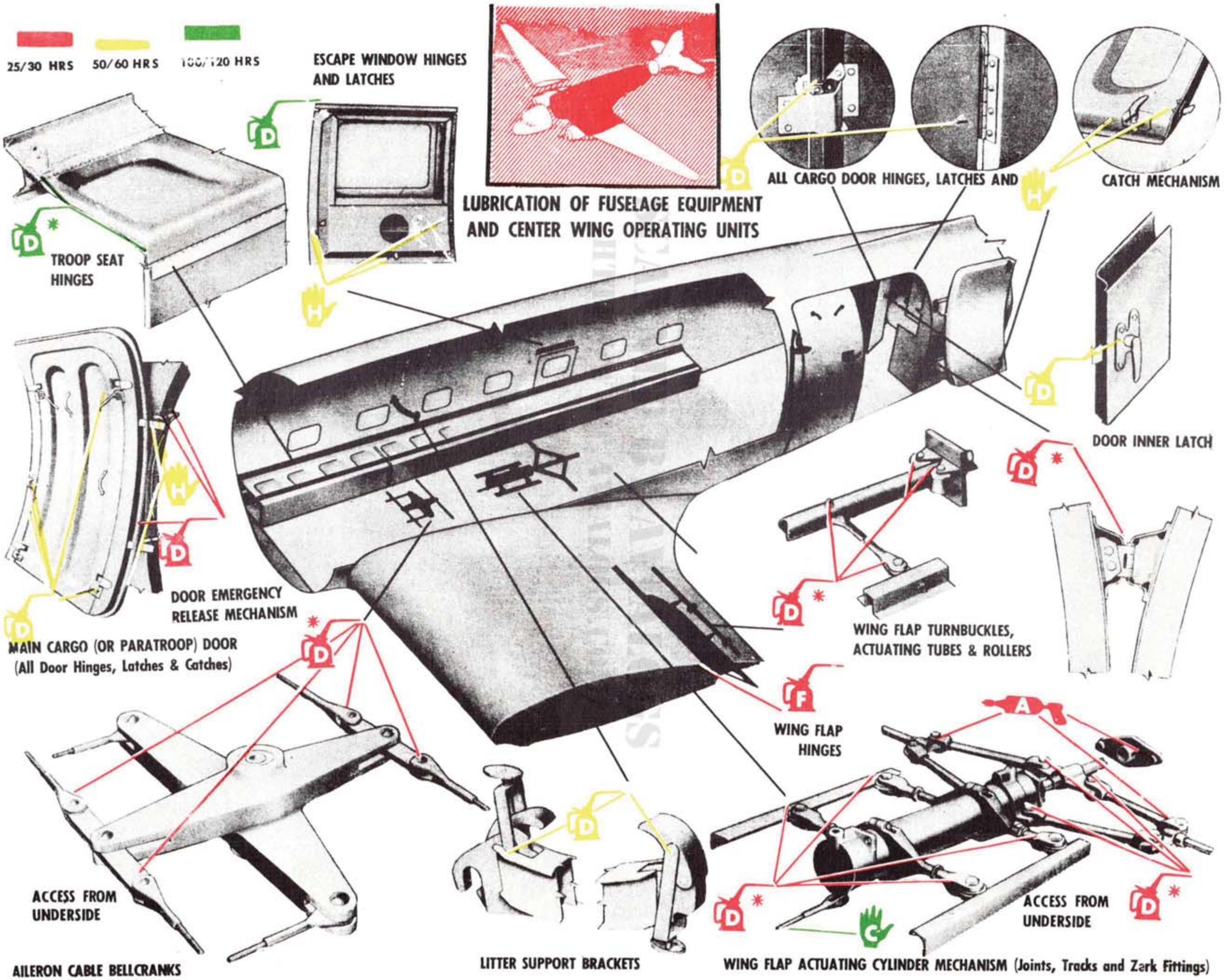
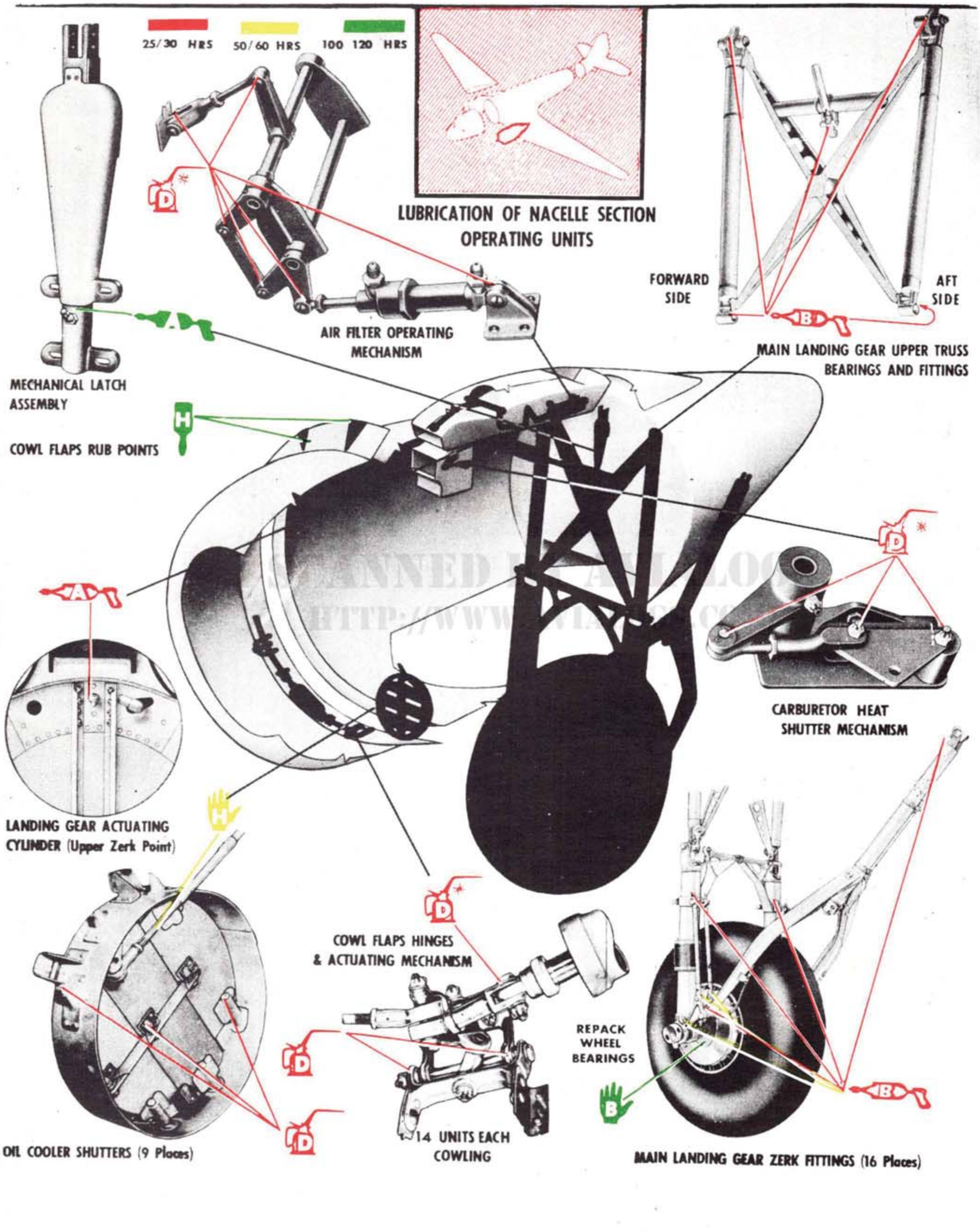

25/30 HRS
50/60 HRS
100/120 HRS
ESCAPE WINDOW HINGES AND LATCHES
LUBRICATION OF FUSELAGE EQUIPMENT AND CENTER WING OPERATING UNITS
ALL CARGO DOOR HINGES, LATCHES AND
CATCH MECHANISM
D
H
TROOP SEAT HINGES
DOOR INNER LATCH
DOOR EMERGENCY RELEASE MECHANISM
MAIN CARGO (OR PARATROOP) DOOR (All Door Hinges, Latches & Catches)
WING FLAP TURNBUCKLES, ACTUATING TUBES & ROLLERS
F
WING FLAP HINGES
A
ACCESS FROM UNDERSIDE
ACCESS FROM UNDERSIDE
G
AILERON CABLE BELLCRANKS
LITTER SUPPORT BRACKETS
WING FLAP ACTUATING CYLINDER MECHANISM (Joints, Tracks and Zerk Fittings)
*

Figure 84—Lubrication Chart (Sheet 3 of 5 Sheets)


🟥 25/30 HRS
🟨 50/60 HRS
🟩 100 120 HRS
LUBRICATION OF NACELLE SECTION OPERATING UNITS
D
AIR FILTER OPERATING MECHANISM
FORWARD SIDE
AFT SIDE
B
MAIN LANDING GEAR UPPER TRUSS BEARINGS AND FITTINGS
A
MECHANICAL LATCH ASSEMBLY
H
COWL FLAPS RUB POINTS
D
CARBURETOR HEAT SHUTTER MECHANISM
A
LANDING GEAR ACTUATING CYLINDER (Upper Zerk Point)
H
D
COWL FLAPS HINGES & ACTUATING MECHANISM
D
REPACK WHEEL BEARINGS
B
B
D
OIL COOLER SHUTTERS (9 Places)
14 UNITS EACH COWLING
MAIN LANDING GEAR ZERK FITTINGS (16 Places)

SCANNED BY AVIALOGS HTTP://WWW.AVIALOGS.COM

Figure 84—Lubrication Chart (Sheet 4 of 5 Sheets)

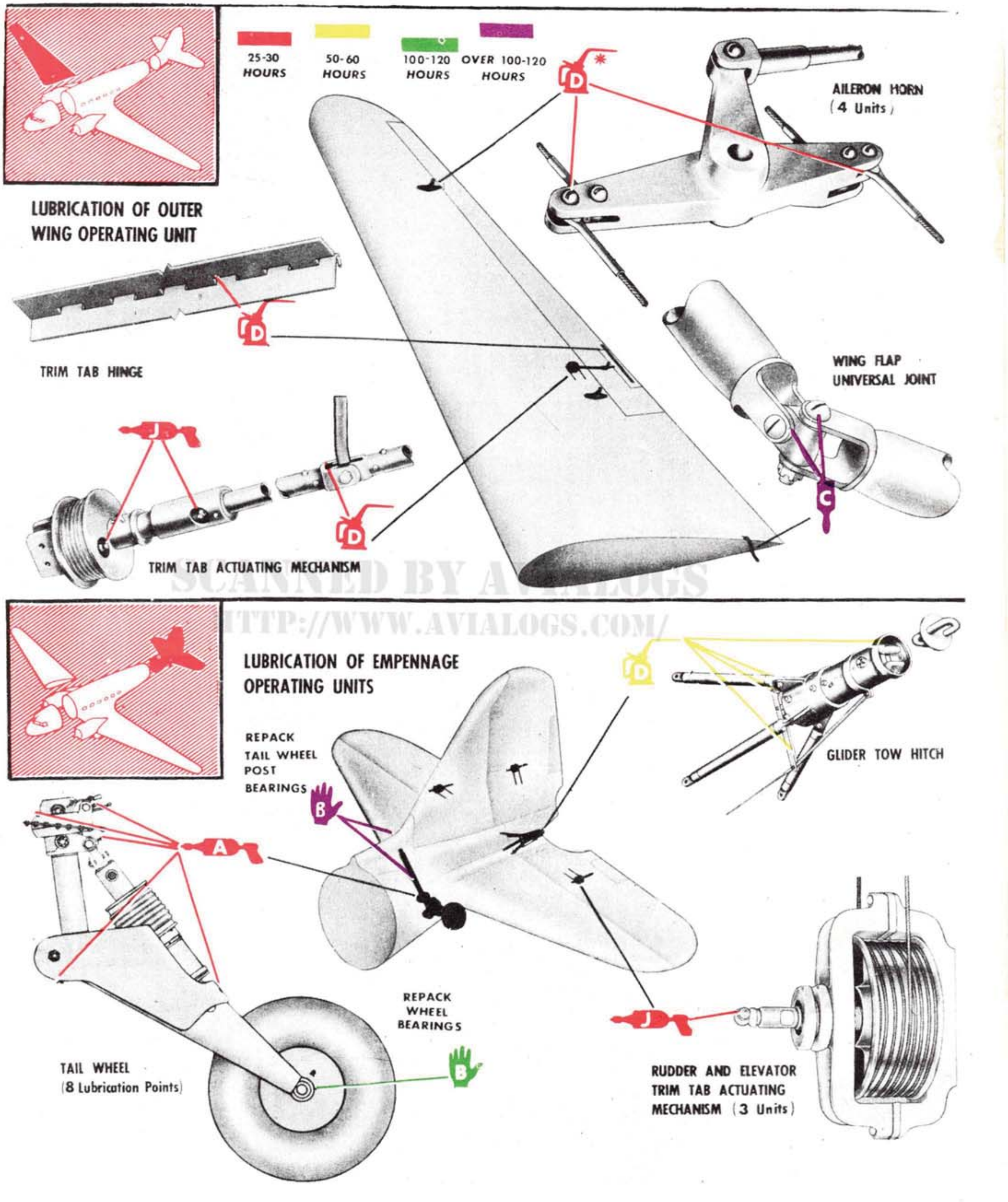

25-30 HOURS
50-60 HOURS
100-120 HOURS
OVER 100-120 HOURS
LUBRICATION OF OUTER WING OPERATING UNIT
D
AILERON HORN (4 Units)
TRIM TAB HINGE
D
WING FLAP UNIVERSAL JOINT
J
D
C
TRIM TAB ACTUATING MECHANISM
LUBRICATION OF EMPENNAGE OPERATING UNITS
D
GLIDER TOW HITCH
REPACK TAIL WHEEL POST BEARINGS
B
A
REPACK WHEEL BEARINGS
B
J
TAIL WHEEL (8 Lubrication Points)
RUDDER AND ELEVATOR TRIM TAB ACTUATING MECHANISM (3 Units)

Figure 84—Lubrication Chart (Sheet 5 of 5 Sheets)

b. SPECIAL SERVICE TOOLS.

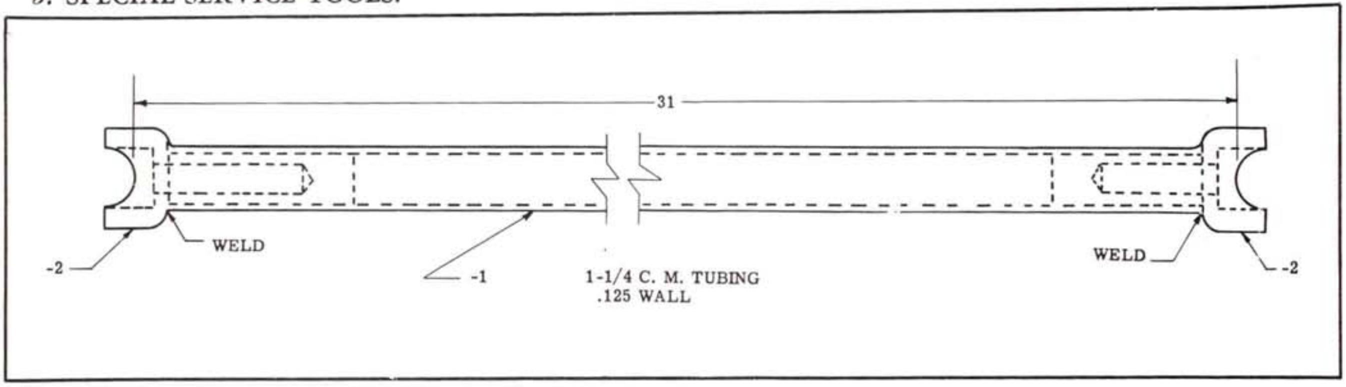

31
WELD
-2
-1
1-1/4 C. M. TUBING
.125 WALL
WELD
-2

Figure 85—Bungee Spreader Bar

MATERIALS

Make from 1-1/4 standard weight x 32-1/2 black iron pipe

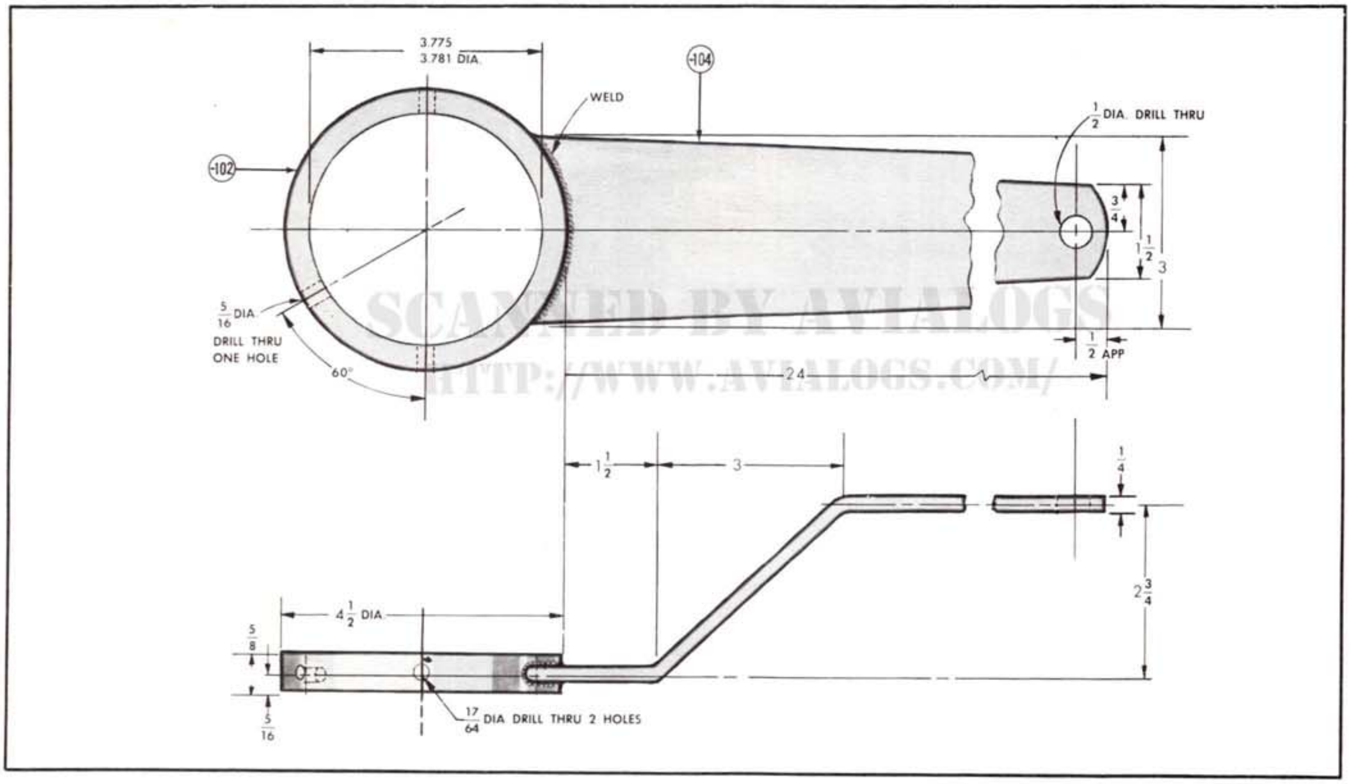

3.775
3.781 DIA.
104
WELD
1/2 DIA. DRILL THRU
102
3/4
1 1/2
3
5/16 DIA.
DRILL THRU
ONE HOLE
60°
1/2 APP
24
1 1/2
3
1/4
2 3/4
4 1/2 DIA.
5/8
5/16
17/64 DIA. DRILL THRU 2 HOLES

Figure 86—Main Landing-Gear Axle Nut Wrench (K20101)

MANUFACTURING NOTES

1. Heat treat
   a. Rockwell 15N 79-80.5
   b. Case depth .020-.025
2. Sandblast and cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
104	1	1/4 x 3 x 25-3/4 SAE 1020 C.R.
102	1	4-1/2 OD x 3/8 wall x 3/4 SAE 1015 tube

MANUFACTURING NOTES

1. Heat treat to Rockwell C40-C43
2. Cadmium plate

MATERIALS

Make from 3/16 x 1-1/16 x 6-5/8 SAE 1095 H.R.

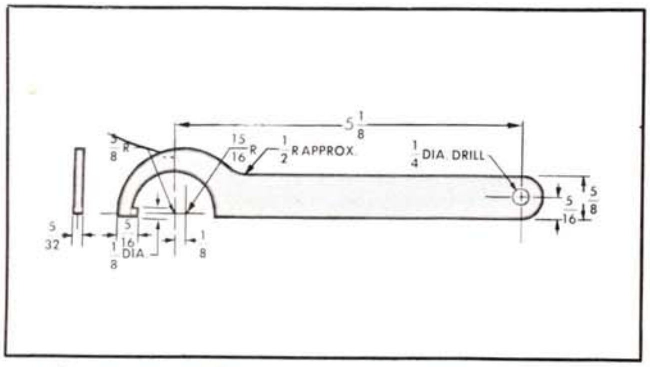
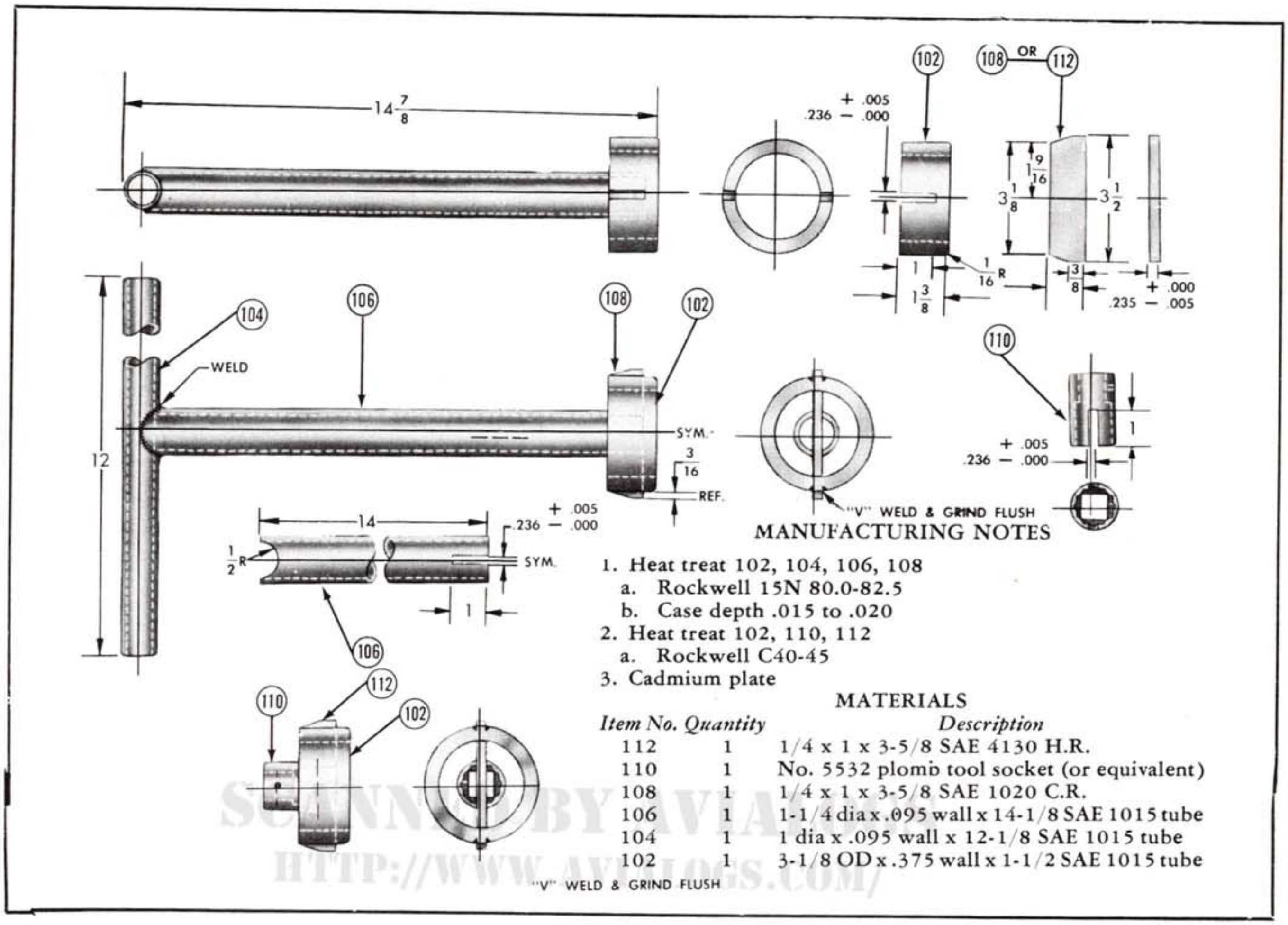

5 1/8
3/8 R
15/16 R
1/2 R APPROX.
1/4 DIA. DRILL
5/8
5/16
5/32
1/8
5/16 DIA.
1/8

Figure 87—Tail Wheel Spindle Ball End Wrench (K20801)


14 7/8
+ .005
.236 − .000
102
108 OR 112
1 9/16
3 1/8
3 1/2
1
1/16 R
1 3/8
3/8
+ .000
.235 − .005
12
104
WELD
106
108
102
SYM.
3/16
REF.
110
+ .005
.236 − .000
1
"V" WELD & GRIND FLUSH
14
+ .005
.236 − .000
1/2 R
SYM.
1
106
112
110
102
"V" WELD & GRIND FLUSH

MANUFACTURING NOTES

1. Heat treat 102, 104, 106, 108
   a. Rockwell 15N 80.0-82.5
   b. Case depth .015 to .020
2. Heat treat 102, 110, 112
   a. Rockwell C40-45
3. Cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
112	1	1/4 x 1 x 3-5/8 SAE 4130 H.R.
110	1	No. 5532 plomb tool socket (or equivalent)
108	1	1/4 x 1 x 3-5/8 SAE 1020 C.R.
106	1	1-1/4 dia x .095 wall x 14-1/8 SAE 1015 tube
104	1	1 dia x .095 wall x 12-1/8 SAE 1015 tube
102	1	3-1/8 OD x .375 wall x 1-1/2 SAE 1015 tube

Figure 88—Tail Wheel Spindle Cap Wrench (K20901)

MATERIALS

Item No.	*Quantity*	*Description*
108	2	5/16-18 standard hex nut
106	2	7/16-18 x 4-1/2 Rd hd machine bolt
104	2	1/8 x 1-1/2 x 4 SAE 1020 H.R.
102	2	1-1/2 x 3-3/8 x 14 hardwood

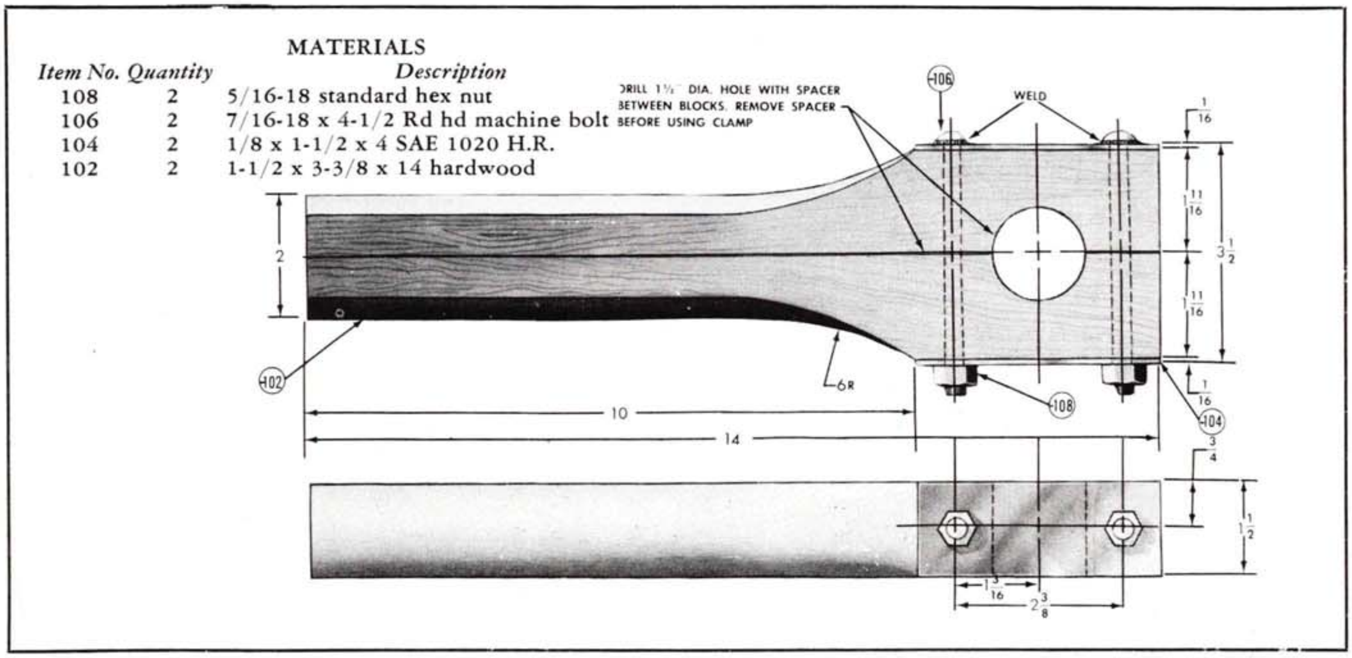

DRILL 1½" DIA. HOLE WITH SPACER BETWEEN BLOCKS. REMOVE SPACER BEFORE USING CLAMP
106
WELD
1/16
1 11/16
3 1/2
1 11/16
1/16
2
102
6R
108
104
10
14
3/4
1 1/2
1 3/16
2 3/8

Figure 89—Hydraulic Cylinder Piston Rod Clamp (Substitute for K21713 and K21714)

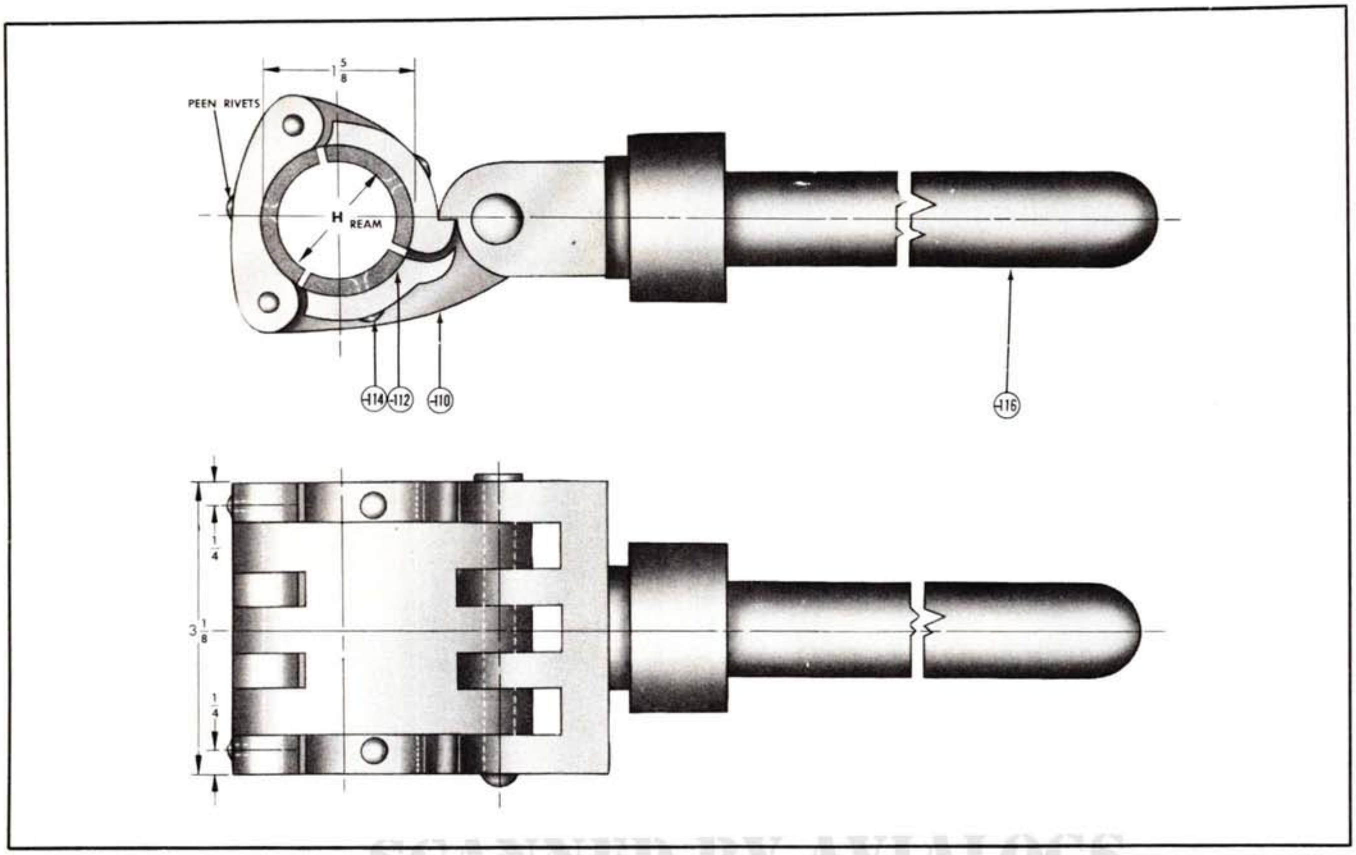

1 5/8
PEEN RIVETS
H
REAM
-114
-112
-110
-116
1/4
3 1/8
1/4

Figure 90—Hydraulic Cylinder Piston Rod Friction Wrench (K21713 and K21714)

MANUFACTURING NOTES

Tool No.	*H.Ream*	*Remarks*
K21713	1.250 1.245	For 1-1/4 inch piston
K21714	1.375 1.370	For 1-3/8 inch piston

MATERIALS

Item No.	*Quantity*	*Description*
116	1	Walworth Parmalee No. 2 friction wrench
114	6	1/8 dia x 1/2 flathead steel rivets
112	1	1-5/8 dia x 3-1/8 brass rod
110	1	1-1/4 pipe-style No. 2 Walworth Parmalee pipe girth

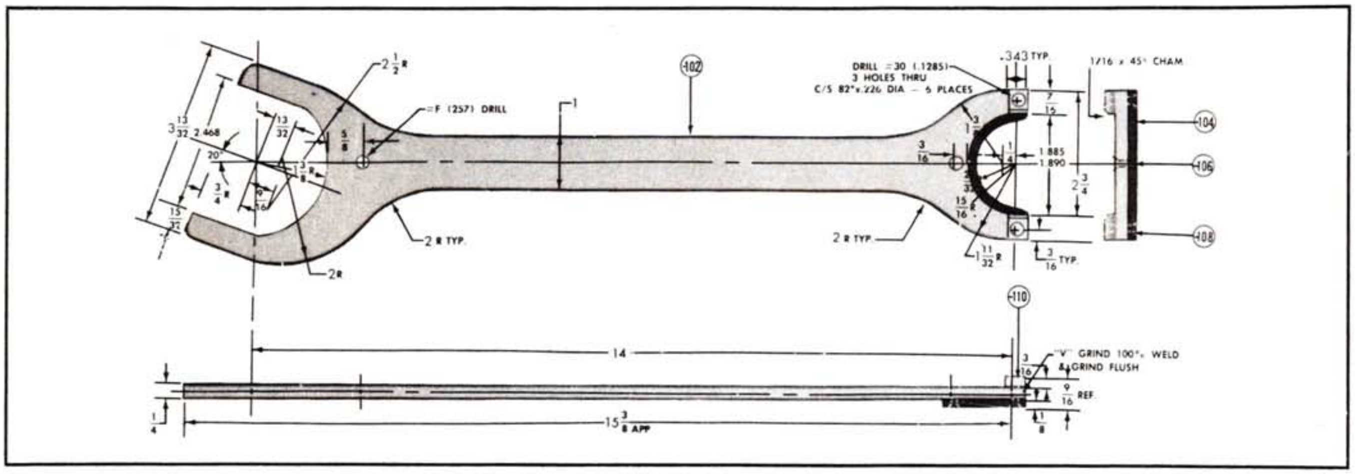

2 1/2 R
-102
=F (.257) DRILL
1
3 13/32
2.468
13/32
5/8
20°
3/8 R
3/4 R
9/16
15/32
2 R TYP.
2R
DRILL =30 (.1285)
3 HOLES THRU
C/S 82°x.226 DIA — 6 PLACES
.343 TYP.
1/16 x 45° CHAM
7/16
1 3/8
3/16
1/4
1.885
1.890
2 3/4
3/32
15/16 R
2 R TYP.
1 11/32 R
3/16 TYP.
-104
-106
-108
-110
14
"V" GRIND 100°, WELD
& GRIND FLUSH
3/16
9/16 REF.
1/8
1/4
15 3/8 APP

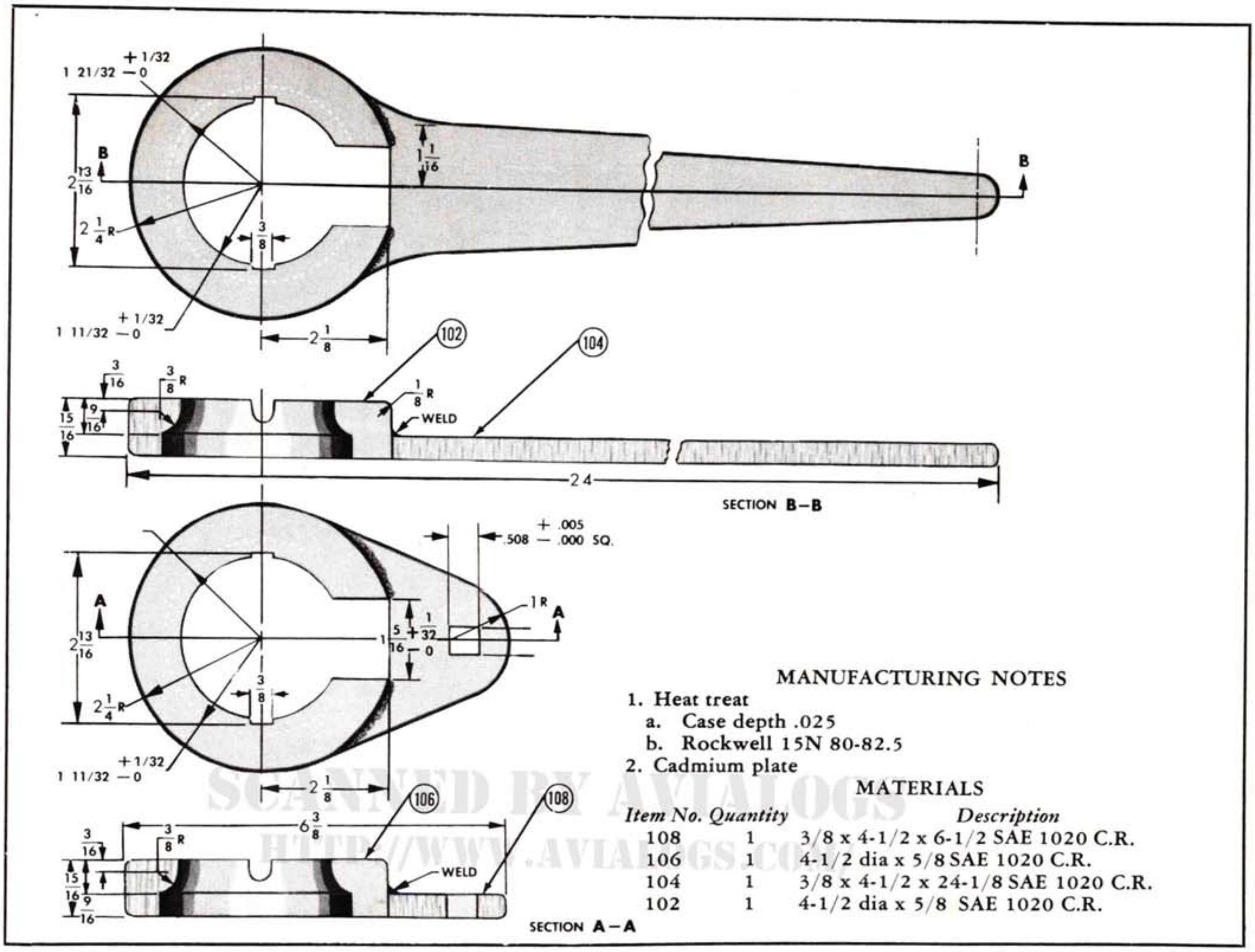
Figure 91—Landing-Gear Retracting Cylinder and Wing Flap Operating Cylinder Packing Wrench (K20001)

MANUFACTURING NOTES

1. Heat treat 102 and 110, oil quench
   a. Case depth .020
   b. Rockwell 15N 80-82.5
2. Cadmium plate
3. Break all sharp edges except lugs

MATERIALS

Item No.	*Quantity*	*Description*
110	2	3/16 x 3/8 x 5/8 SAE 1020 C.R.
108	2	1/8 x 5/8 C/S head steel rivet
106	1	1/8 x 1/2 C/S head steel rivet
104	1	1/8 x 1-5/8 x 2-7/8 fiber
102	1	1/4 x 3-3/4 x 15-1/2 SAE 1020 C.R.


+1/32
1 21/32 −0
B
2 13/16
2 1/4 R
3/8
1 1/16
B
+1/32
1 11/32 −0
2 1/8
102
104
3/16
3/8 R
1/8 R
WELD
15/16
9/16
24
SECTION B−B
+ .005
.508 − .000 SQ.
A
2 13/16
1 R
A
1 5/16 +1/32 −0
3/8
2 1/4 R
+1/32
1 11/32 −0
2 1/8
106
108
6 3/8
3/16
3/8 R
WELD
15/16
9/16
SECTION A−A

MANUFACTURING NOTES

1. Heat treat
   a. Case depth .025
   b. Rockwell 15N 80-82.5
2. Cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
108	1	3/8 x 4-1/2 x 6-1/2 SAE 1020 C.R.
106	1	4-1/2 dia x 5/8 SAE 1020 C.R.
104	1	3/8 x 4-1/2 x 24-1/8 SAE 1020 C.R.
102	1	4-1/2 dia x 5/8 SAE 1020 C.R.

Figure 92—Main Landing-Gear Retracting Cylinder (K21101)

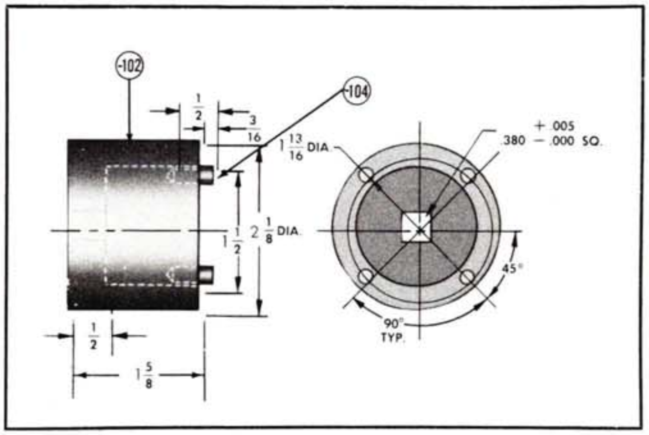

102
104
1/2
3/16
1 13/16 DIA.
+ .005
.380 − .000 SQ.
1 1/2
2 1/8 DIA.
45°
90° TYP.
1/2
1 5/8

Figure 93—Wing Flap Actuating Cylinder Dash-Pot Wrench (K22101)

MANUFACTURING NOTES

1. Heat treat 102
   a. Case depth .010 file hard
2. Cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
104	4	.185 dia x 5/8 No. 34 drill rod
102	1	2-1/8 dia x 1-3/4 SAE 1020 C.R.

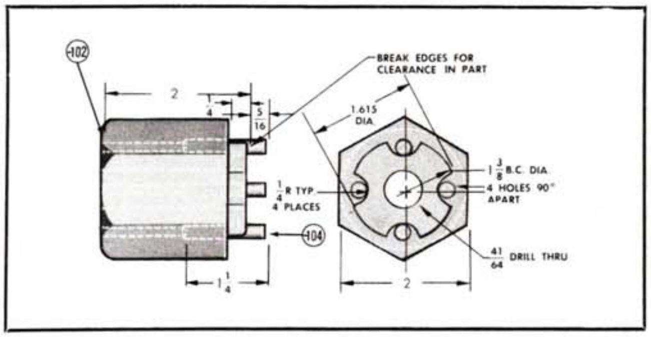

102
BREAK EDGES FOR CLEARANCE IN PART
2
1/4
5/16
1.615 DIA.
1 3/8 B.C. DIA.
4 HOLES 90° APART
1/4 R TYP. 4 PLACES
104
41/64 DRILL THRU
1 1/4
2

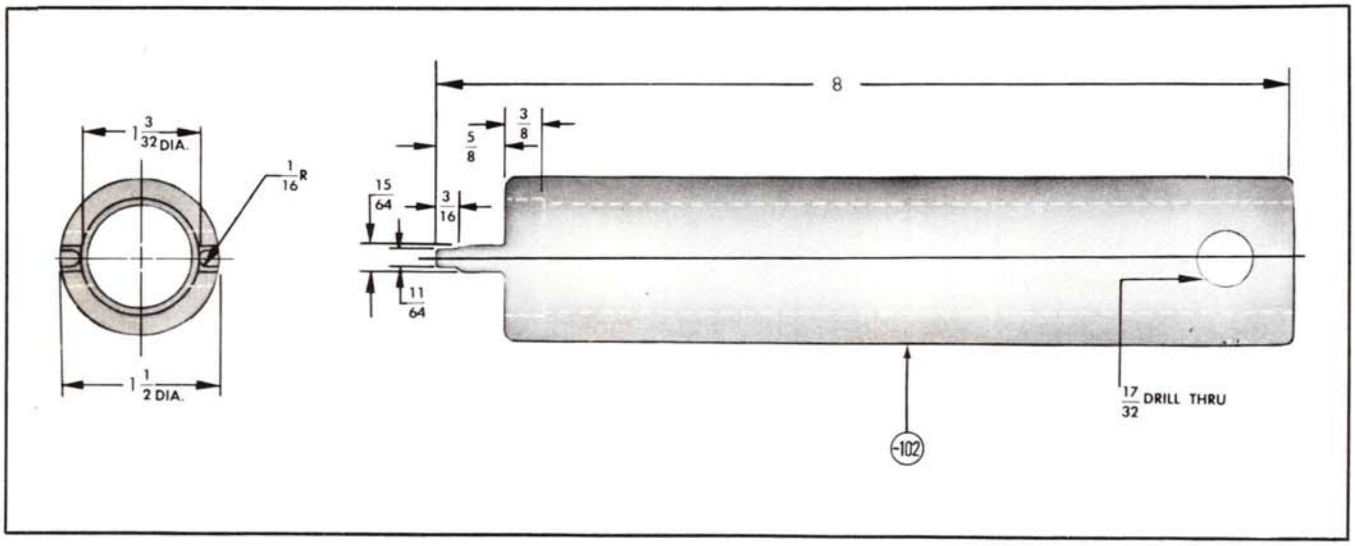
Figure 94—Engine Cowl Flap Operating Cylinder End Wrench (K20401)

MANUFACTURING NOTES

1. Heat treat 102
   a. Case depth .030
   b. Rockwell C45-48
2. Heat treat 104
   a. Rockwell C45-48
3. Cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
104	4	.212 dia x 1-3/8 No. 34 drill rod
102	1	2 hex. x 2-1/8 SAE 1020 C.R.



8
$1\frac{3}{32}$ DIA.
$\frac{1}{16}$R
$\frac{5}{8}$
$\frac{3}{8}$
$\frac{15}{64}$
$\frac{3}{16}$
$\frac{11}{64}$
$1\frac{1}{2}$ DIA.
$\frac{17}{32}$ DRILL THRU
102

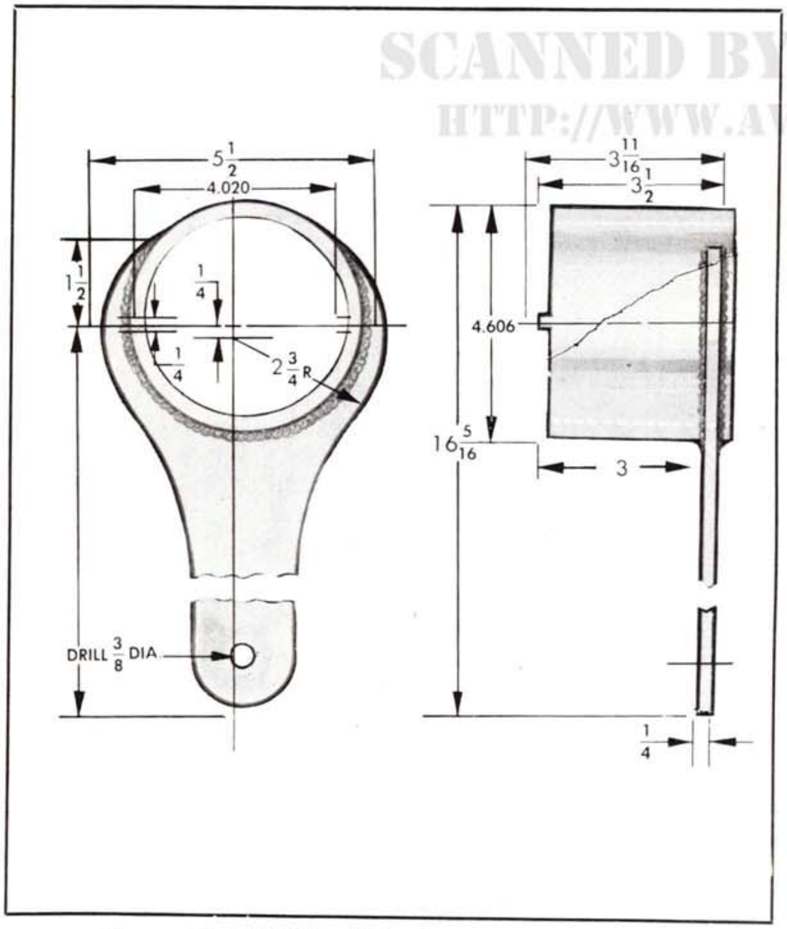
Figure 95—Hydraulic Pressure Regulator Valve Nut Wrench (K21201)

MANUFACTURING NOTES

1. Heat treat
   a. Case depth .010 file hard
2. Cadmium plate

MATERIALS

Make from 1-1/2 OD x 5/16 wall x 8-1/8 SAE 1015 tube



$5\frac{1}{2}$
4.020
$1\frac{1}{2}$
$\frac{1}{4}$
$\frac{1}{4}$
$2\frac{3}{4}$R
DRILL $\frac{3}{8}$ DIA.
$3\frac{11}{16}$
$3\frac{1}{2}$
4.606
$16\frac{5}{16}$
3
$\frac{1}{4}$

Figure 96—Tail Wheel Shock Strut Packing Gland Wrench (K20501)

MANUFACTURING NOTES

1. Heat treat
   a. Case depth .015
   b. Rockwell 15N 79-81
2. Cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
Barrel	1	4-5/8 OD x .312 wall x 3-13/16 SAE 1025 tube C.R.
Handle	1	1/4 x 5-1/2 x 15-5/8 SAE 1020 C.R.

KEY TO FIGURE 97

MANUFACTURING NOTES

1. Heat treat 102 and 104
   a. Case depth .015
   b. Rockwell 15N 89-92
2. Heat treat 110
   a. Rockwell C45-50
3. Smooth machine finish all over
4. Cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
122	1	1/4 x 1 x 2-5/8 SAE 1020 C.R.
120	1	13/16 OD x .156 wall x 8-13/16 SAE 1015 tube
118	1	1/2 OD x .065 wall x 3-5/8 SAE 1015 tube
116	1	1/4 x 1 x 2-3/4 SAE 1020 C.R.
114	1	1/8 dia steel ball
112	1	.020 gage x 2-1/2 music wire
110	1	7/8 dia x 8-1/4 SAE 4130 H.R.
108	1	1/4 dia x 4 SAE 1020 C.R.
106	1	1/8 dia x 3/4 No. 34 drill rod
104	1	Weld assembly as shown
102	1	Weld assembly as shown

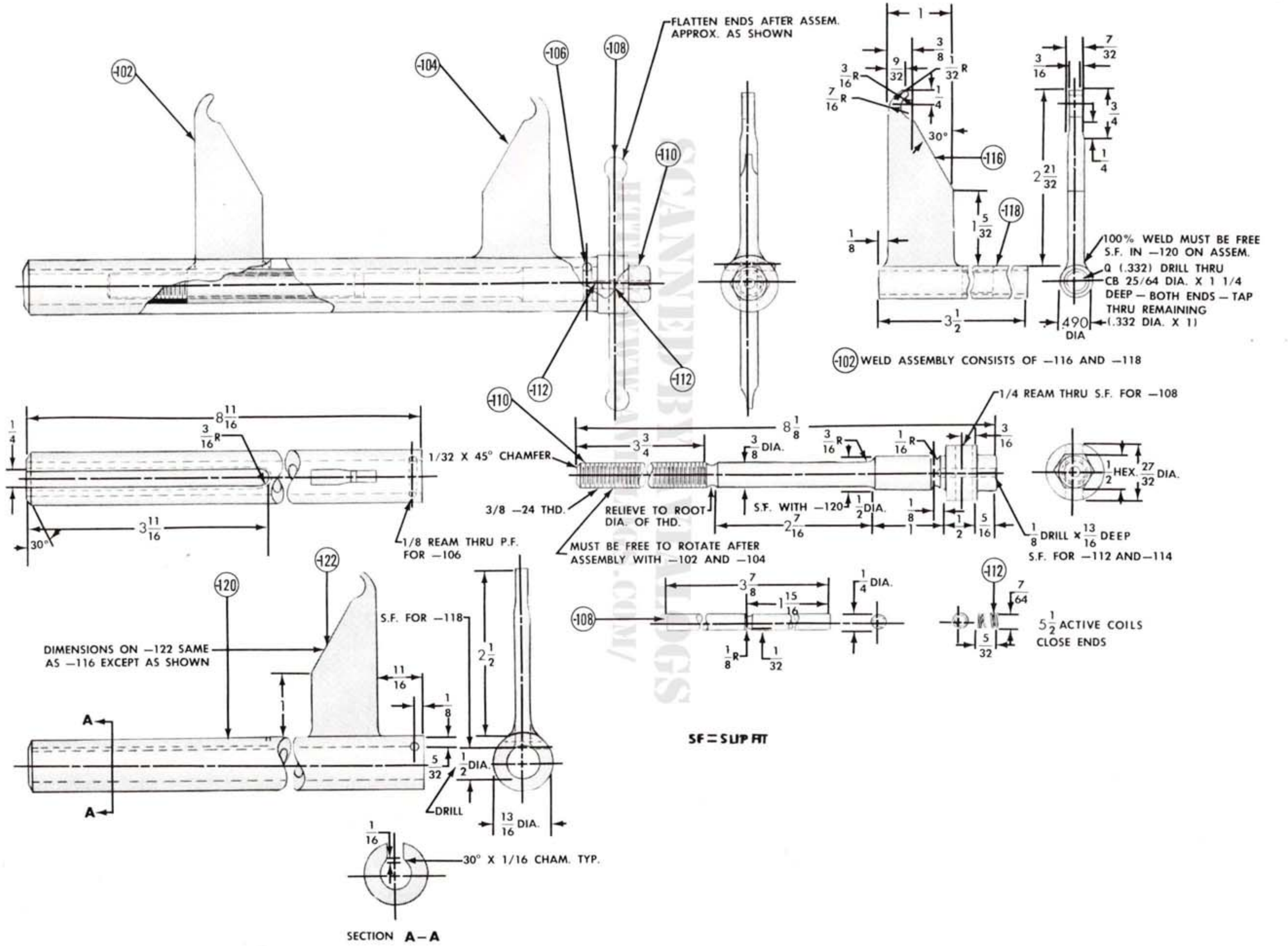

-102
-104
-106
-108
-110
-112
-112
FLATTEN ENDS AFTER ASSEM. APPROX. AS SHOWN
1
3/8
9/32
1/32 R
3/16 R
7/16 R
1/4
30°
-116
1 5/32
-118
1/8
3 1/2
3/16
7/32
3/4
1/4
2 21/32
100% WELD MUST BE FREE S.F. IN -120 ON ASSEM.
Q (.332) DRILL THRU
CB 25/64 DIA. X 1 1/4 DEEP – BOTH ENDS – TAP THRU REMAINING (.332 DIA. X 1)
.490 DIA
-102 WELD ASSEMBLY CONSISTS OF -116 AND -118
1/4 REAM THRU S.F. FOR -108
-110
8 1/8
3 3/4
3/8 DIA.
3/16 R
1/16 R
3/16
1/32 X 45° CHAMFER
3/8 -24 THD.
RELIEVE TO ROOT DIA. OF THD.
MUST BE FREE TO ROTATE AFTER ASSEMBLY WITH -102 AND -104
S.F. WITH -120
1/2 DIA.
2 7/16
1/8
1/2
5/16
1/8 DRILL × 13/16 DEEP
S.F. FOR -112 AND -114
1/2 HEX.
27/32 DIA.
8 11/16
1/4
3/16 R
3 11/16
30°
1/8 REAM THRU P.F. FOR -106
-108
3 7/8
1 15/16
1/8 R
1/32
1/4 DIA.
-112
7/64
5/32
5 1/2 ACTIVE COILS CLOSE ENDS
SF = SLIP FIT
-120
-122
DIMENSIONS ON -122 SAME AS -116 EXCEPT AS SHOWN
S.F. FOR -118
11/16
1/8
2 1/2
5/32
1/2 DIA.
DRILL
13/16 DIA.
A
A
1/16
30° X 1/16 CHAM. TYP.
SECTION A-A

Figure 97—Fuel Tank Strap Puller (K35401)

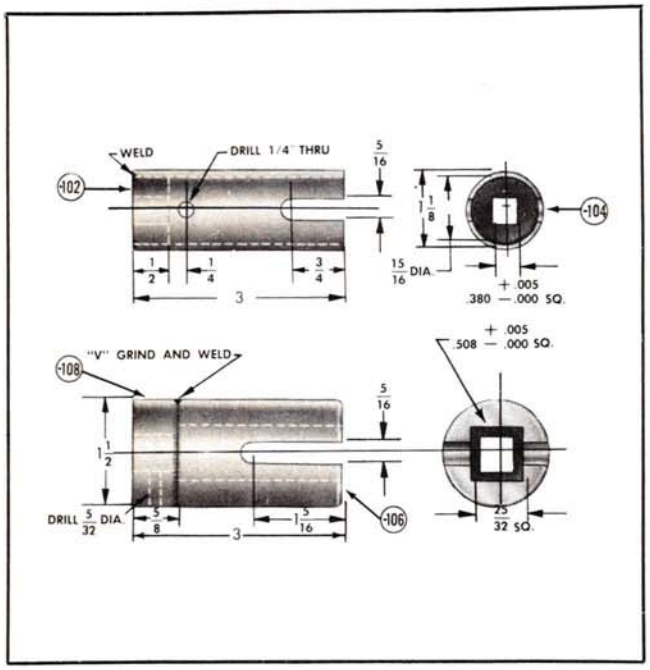

WELD
DRILL 1/4" THRU
-102
5/16
1 1/8
-104
1/2
1/4
3/4
3
15/16 DIA.
+ .005
.380 — .000 SQ.
+ .005
.508 — .000 SQ.
"V" GRIND AND WELD
-108
5/16
1 1/2
DRILL 5/32 DIA.
5/8
1 5/16
3
-106
25/32 SQ.

Figure 98—Fuel Tank Sump Drain Wrench (K21601)

MANUFACTURING NOTES
1. Heat treat
   a. Case depth .020
   b. Rockwell 15N 80-83
2. Cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
108	1	1-1/2 dia x 3/4 SAE 1020 C.R.
106	1	1-1/2 dia x 2-1/2 SAE 1020 C.R.
104	1	15/16 dia x 5/8 SAE 1020 C.R.
102	1	1-1/8 dia x .095 wall x 3-1/8 SAE 1025 tube

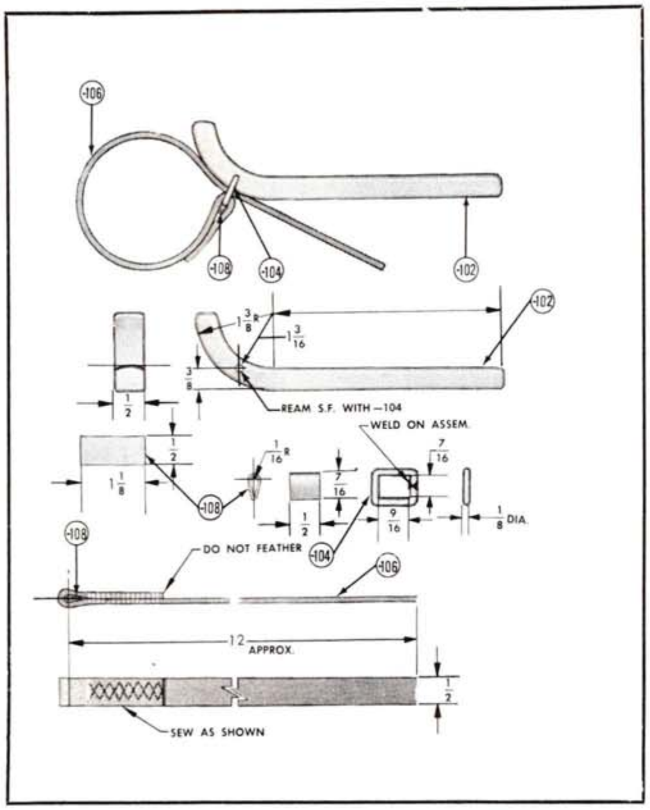
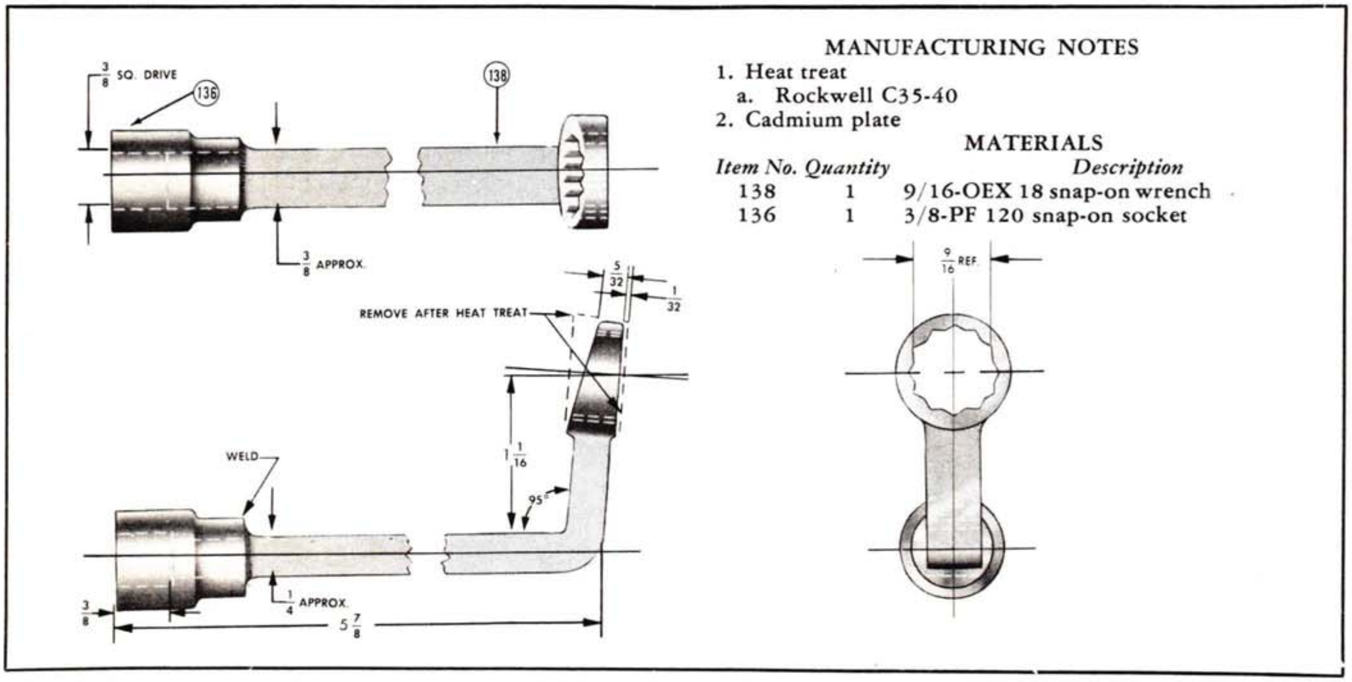

-106
-108
-104
-102
-102
1 3/8 R
1 3/16
3/8
1/2
REAM S.F. WITH -104
WELD ON ASSEM.
1/2
1 1/8
-108
1/16 R
7/16
7/16
1/2
9/16
1/8 DIA.
-104
-108
DO NOT FEATHER
-106
12 APPROX.
1/2
SEW AS SHOWN

Figure 100—Strap Wrench (K30503)

MATERIALS

Item No.	*Quantity*	*Miscellaneous*
108	1	.031 x 1/2 x 1-1/8 SAE 1020 H.R. sheet stock
106	1	1/2 x 16 hood lacing
104	1	1/8 dia x 2-1/2 SAE 1020 C.R.
102	1	3/8 x 1/2 x 8 (+2) SAE 1020 H.R.


3/8 SQ. DRIVE
-136
-138
3/8 APPROX.
5/32
1/32
REMOVE AFTER HEAT TREAT
1 1/16
95°
WELD
1/4 APPROX.
3/8
5 7/8
9/16 REF.

MANUFACTURING NOTES
1. Heat treat
   a. Rockwell C35-40
2. Cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
138	1	9/16-OEX 18 snap-on wrench
136	1	3/8-PF 120 snap-on socket

Figure 99—Starter and Generator Crow Foot Wrench (K32308)

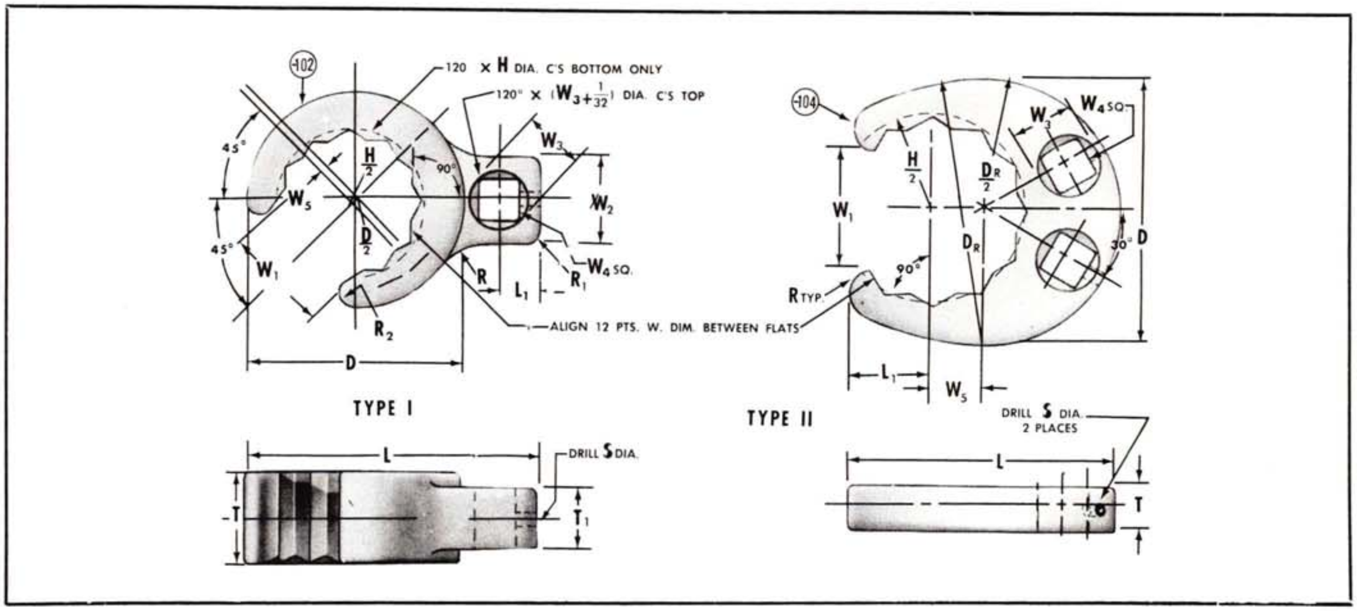


Figure 101—Crow Foot Square Drive Wrench

K21909
K21910
K21911
K21901
K21902
K21903
K21912
K21913
K21904
K21914
K21905
K21915
K21916
K21906
K21917
K21918
K21919
K21907
K21920
K21921
K21922
K21923
K21908
K21924

MANUFACTURING NOTES

Tolerance Serv. Tool	Type	D	L	L_1	+0 −1/32 T	+0 −1/32 T_1	+.005 −.000 W	+.005 −.005 W_1	W_2	W_3	+.005 −.000 W_4	W_5	+1/64 −0 H	R	R_1	R_2	S
K21909	I	27/32	1-25/64	9/32	3/8	3/8	.379	.313	17/32	.344	.254	1/32	29/64	7/16	1/16	1/16	3/32
K21910	I	27/32	1-25/64	9/32	3/8	3/8	.440	.363	17/32	.344	.254	1/32	17/32	7/16	1/16	1/16	3/32
K21911	I	31/32	1-33/64	9/32	7/16	7/16	.504	.414	17/32	.344	.254	1/32	19/32	1/2	1/16	5/64	3/32
K21901	I	1-3/16	1-7/8	25/64	1/2	1/2	.566	.467	3/4	.527	.380	3/64	43/64	3/4	1/8	1/8	9/64
K21902	I	1-3/16	1-7/8	25/64	1/2	1/2	.630	.518	3/4	.527	.380	3/64	3/4	3/4	1/8	3/32	9/64
K21903	I	1-3/16	1-7/8	25/64	1/2	1/2	.693	.569	3/4	.527	.380	3/64	53/64	3/4	1/8	3/32	9/64
K21912	I	1-1/2	2-3/16	25/64	5/8	7/16	.755	.622	25/32	.527	.380	1/16	29/32	1	1/8	7/64	9/64
K21913	I	1-1/2	2-3/16	25/64	5/8	7/16	.818	.672	25/32	.527	.380	1/16	31/32	1	1/8	7/64	9/64
K21904	I	1-1/2	2-3/16	25/64	5/8	7/16	.881	.724	25/32	.527	.380	1/16	1-3/64	1	1/8	7/64	9/64
K21914	I	1-1/2	2-3/16	25/64	5/8	7/16	.944	.766	25/32	.527	.380	1/16	1-1/8	1	1/8	3/32	9/64
K21905	I	1-23/32	2-29/64	31/64	3/4	21/32	1.006	.828	13/16	.527	.380	1/16	1-13/64	7/8	3/16	1/8	9/64
K21915	I	1-23/32	2-29/64	31/64	3/4	21/32	1.068	.878	13/16	.527	.380	1/16	1-17/64	7/8	3/16	1/8	9/64
K21916	I	1-23/32	2-29/64	31/64	3/4	21/32	1.132	.931	13/16	.527	.380	1/16	1-11/32	7/8	3/16	3/32	9/64
K21906	I	2-1/16	2-13/16	31/64	7/8	21/32	1.195	.982	13/16	.527	.380	5/64	1-27/64	3/4	3/16	1/8	9/64
K21917	I	2-1/16	2-13/16	31/64	7/8	21/32	1.258	1.034	13/16	.527	.380	5/64	1-1/2	3/4	3/16	1/8	9/64
K21918	I	2-1/16	2-13/16	31/64	7/8	21/32	1.321	1.086	13/16	.527	.380	5/64	1-9/16	3/4	3/16	3/32	9/64
K21919	I	2-1/16	2-13/16	31/64	7/8	21/32	1.385	1.136	13/16	.527	.380	5/64	1-41/64	3/4	3/16	5/64	9/64
K21907	I	2-9/16	3-1/2	33/64	1-1/16	25/32	1.510	1.240	1-1/32	.708	.508	3/32	1-25/32	3/4	3/16	5/32	9/64
K21920	I	2-9/16	3-1/2	33/64	1-1/16	25/32	1.571	1.290	1-1/32	.708	.508	3/32	1-55/64	3/4	3/16	5/32	9/64
K21921	I	2-9/16	3-1/2	33/64	1-1/16	25/32	1.762	1.445	1-1/32	.708	.508	3/32	2-3/32	3/4	3/16	1/4	9/64
K21922	I	3-3/16	4-5/32	33/64	1-9/32	25/32	2.014	1.653	1-1/32	.708	.508	3/32	2-25/64	3/4	3/16	3/16	9/64
K21923	I	3-3/16	4-5/32	33/64	1-9/32	25/32	2.262	1.858	1-1/32	.708	.508	3/32	2-43/64	3/4	3/16	1/8	9/64
K21908	II	3-3/16	3-11/16	31/32	17/32	....	1.948	1.425	....	.708	.508	5/8	2-5/16	5/16	....	....	9/64
K21924	II	3-5/8	4-3/16	1-1/8	17/32	....	2.325	1.702	....	.708	.508	11/16	2-3/4	5/16	....	....	9/64

1. Heat treat 102 and 104
   a. Rockwell C40-43
2. Heat treat 110
   a. Rockwell C40-43
3. Break all sharp edges
4. Cadmium plate

MATERIALS

Item No.	*Quantity*	*Description*
110	1	"D" dia x 11-1/4 SAE 1095 H.R.
108	2	"D" dia round steel ball
106	2	.002 dia x ("L"+1/2) music wire
104	1	"T" x "D" x ("L"+1/8) SAE 4130 H.R.
102	1	"T" x "D" x ("L"+1/8) SAE 4130 H.R.

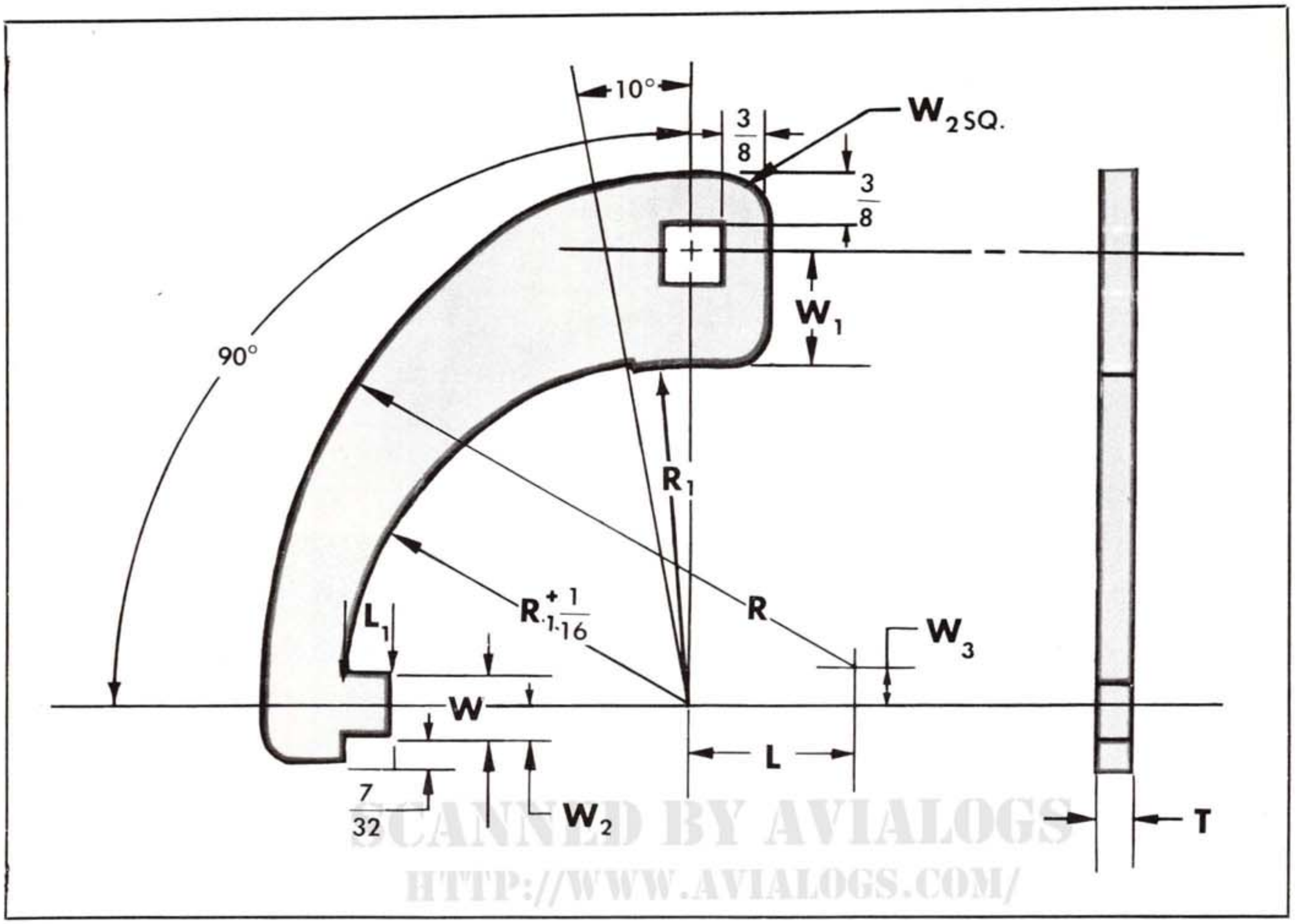

10°
3/8
W2 SQ.
3/8
W1
90°
R1
R +1/16 -1/16
R
L1
W3
W
L
7/32
W2
T

Figure 102—Spanner (Half-Moon) Square Drive Wrench

K26409 K26410 K26413 K26414

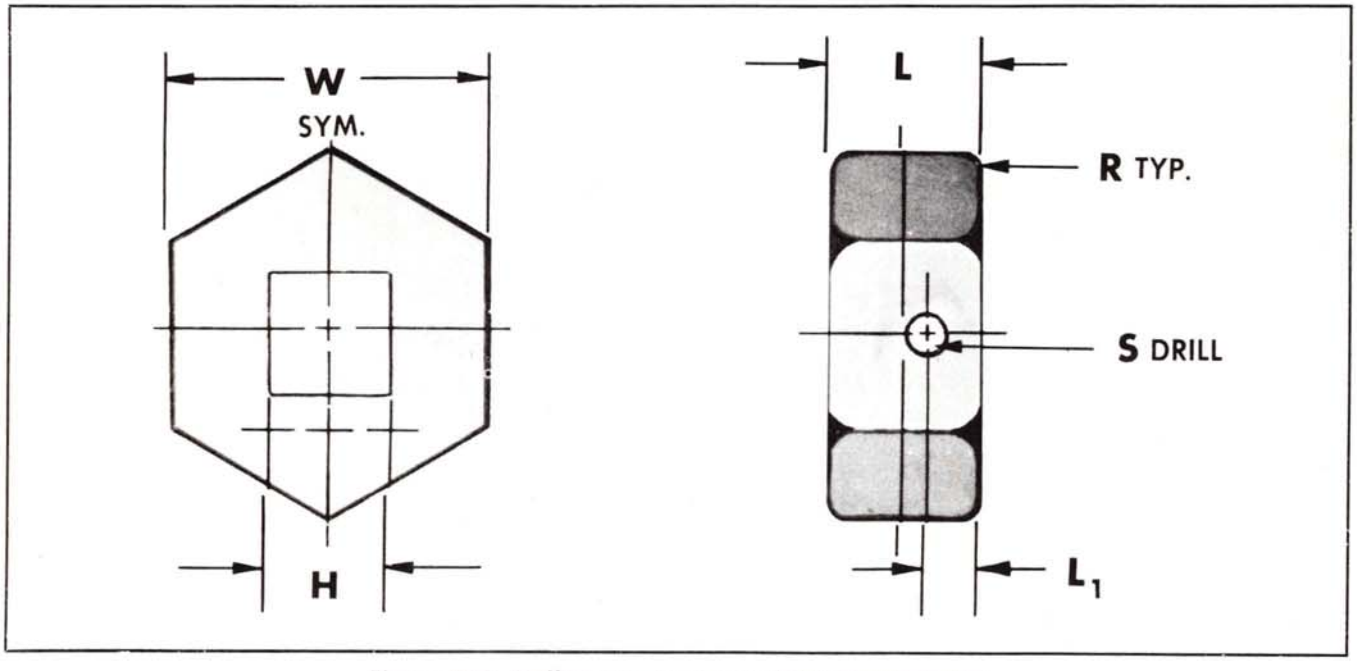

W
SYM.
H
L
R TYP.
S DRILL
L1

Figure 103—Hollow Cap Screw and Nut Hex Adapter

K22201 K22202 K22203 K22204 K22205 K22206 K22207 K22208 K22209

KEY TO FIGURE 102

MANUFACTURING NOTES

Tolerance							+.005 -000				
Service Tool No.	*Material Size*	L	L_1	T	W	W_1	W_2	W_3	R	R_1	*Tool Used On*
K26409	1/4 x 1-3/8 x 2-3/4	1	1/8	1/4	7/64	5/8	.380	1/4	2-1/8	57/64	Hydraulic hand pump packing collar
K26410	1/4 x 1-5/8 x 3-5/8	1-1/16	11/64	1/4	.477	5/8	.380	1/8	2-5/8	1-11/64	Hydraulic hand pump packing nut
K26413	5/16 x 2-1/8 x 5-1/4	1-5/16	5/32	5/16	5/16	15/16	.508	1/8	4-1/16	2-9/32	Tail wheel shock strut packing nut
K26414	5/16 x 2-1/8 x 5-5/8	1-1/4	5/32	5/16	23/64	15/16	.508	1/8	4-1/4	2-7/16	Main wheel shock strut packing nut

1. Heat treat
   a. Rockwell C40-45
2. Break all sharp edges
3. Cadmium plate

MATERIALS

Make from SAE 4130 H.R. from size shown in tabulation.

KEY TO FIGURE 103

MANUFACTURING NOTES

Tolerance			+.000 −.005	+.005 −.000			
Service Tool No.	*L*	L_1	*W Hex.*	*H*	*R*	*S Drill*	*Material Size*
K22201	5/16	13/64	.625	.380	——	1/8	"D" día x "L" +1/8
K22202	5/8	15/64	1.312	.508	1/16	5/32	See above
K22203	7/8	15/64	1.125	.508	1/16	5/32	See above
K22204	9/16	13/64	.687	.380	——	1/8	See above
K22205	5/8	15/64	.875	.508	1/32	5/32	See above
K22206	1/2	13/64	.750	.380	——	1/8	See above
K22207	7/8	15/64	1.000	.508	1/16	5/32	See above
K22208	1-1/16	15/64	1.375	.508	1/16	5/32	See above
K22209	1-1/8	15/64	1.500	.508	1/16	5/32	See above

1. Heat treat
   a. Rockwell C40-45
2. Sandblast
3. Cadmium plate

MATERIALS

Make from SAE 4130 H.R.

c. GROUND HANDLING TOOLS.

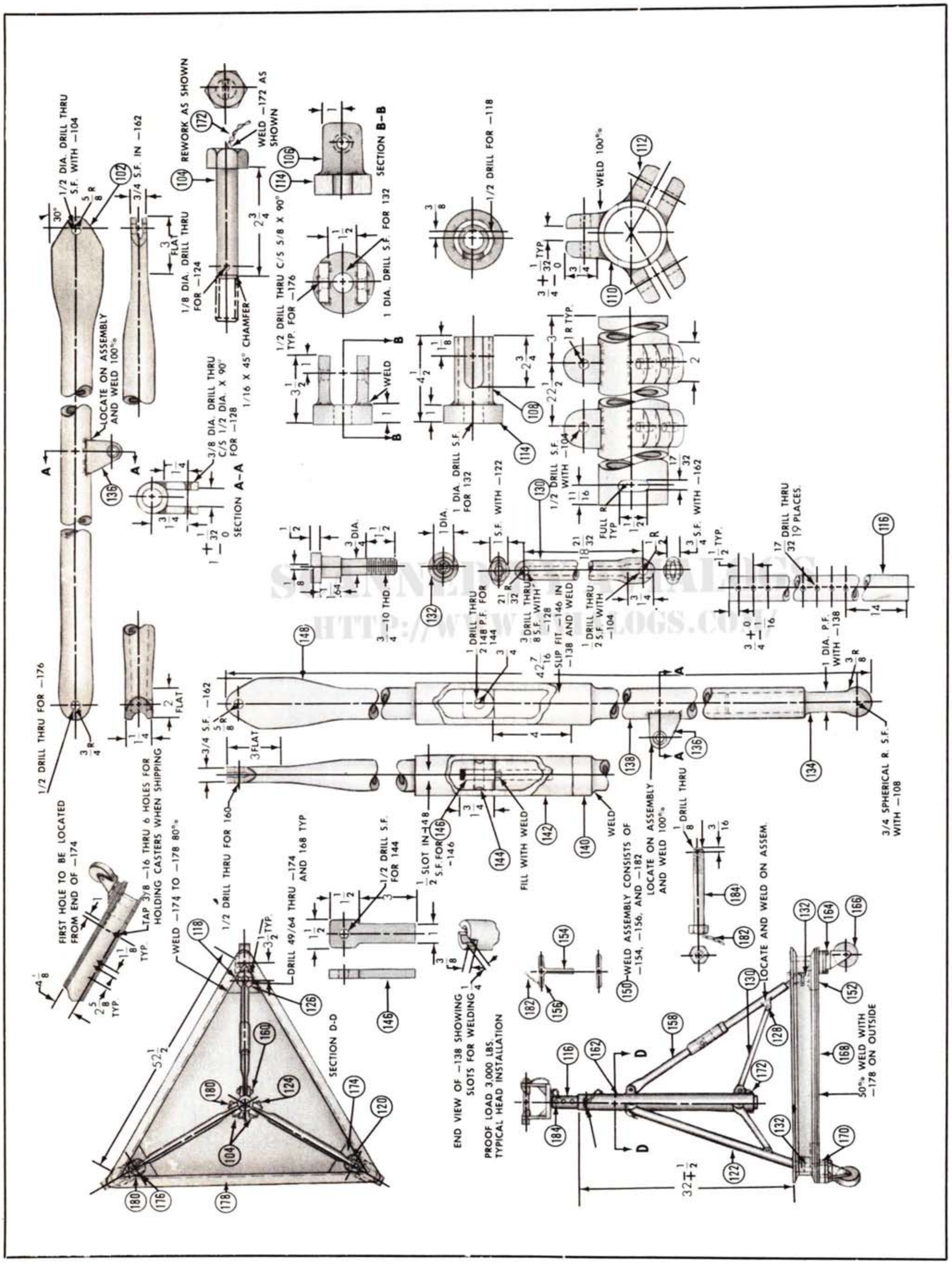

1/2 DIA. DRILL THRU S.F. WITH −104
30°
5/8 R
102
3/4 S.F. IN −162
3 FLAT
LOCATE ON ASSEMBLY AND WELD 100%
1/8 DIA. DRILL THRU FOR −124
CHAMFER
1/16 X 45° CHAMFER
3/8 DIA. DRILL THRU C/S 1/2 DIA. X 90° FOR −128
SECTION A-A
136
A
REWORK AS SHOWN
172
WELD −172 AS SHOWN
104
106
114
SECTION B-B
1/2 DRILL THRU C/S 5/8 X 90° TYP. FOR −176
1 DIA. DRILL S.F. FOR 132
1/2 DRILL FOR −118
WELD 100%
112
110
WELD
B
108
114
1 DIA. DRILL S.F.
1 DIA. DRILL FOR 132
1 R TYP.
1/2 DRILL S.F. WITH −104
FULL R TYP
130
S.F. WITH −122
S.F. WITH −162
DRILL THRU 19 PLACES.
116
1/2 DRILL THRU FOR −176
3/4 R
2 FLAT
3/4 DIA.
3/4 −10 THD.
132
1 DIA.
DRILL THRU 148 P.F. FOR 144
DRILL THRU S.F. WITH −128
SLIP FIT −146 IN −138 AND WELD
DRILL THRU S.F. WITH −104
1 DIA. P.F. WITH −138
3/8 R
148
3/4 S.F. −162
5/8 R
3 FLAT
1/2 DRILL THRU FOR 160
4
138
136
134
3/4 SPHERICAL R. S.F. WITH −108
142
140
WELD
FILL WITH WELD
144
1/2 SLOT IN 148 S.F. FOR −146
146
1/2 DRILL S.F. FOR 144
END VIEW OF −138 SHOWING SLOTS FOR WELDING
PROOF LOAD 3,000 LBS. TYPICAL HEAD INSTALLATION
WELD ASSEMBLY CONSISTS OF −154, −156, AND −182 LOCATE ON ASSEMBLY AND WELD 100%
150
154
156
182
184
DRILL THRU
LOCATE AND WELD ON ASSEM.
FIRST HOLE TO BE LOCATED FROM END OF −174
TAP 3/8 −16 THRU 6 HOLES FOR HOLDING CASTERS WHEN SHIPPING
WELD −174 TO −178 80%
1/2 DRILL THRU FOR 160
DRILL 49/64 THRU −174 AND 168 TYP
118
126
160
180
124
104
174
120
176
178
SECTION D-D
52 1/2
158
162
116
184
D
172
128
130
132
164
166
152
168
170
122
50% WELD WITH −178 ON OUTSIDE
32 1/2

Figure 104—Universal Tail Stand (K12402)

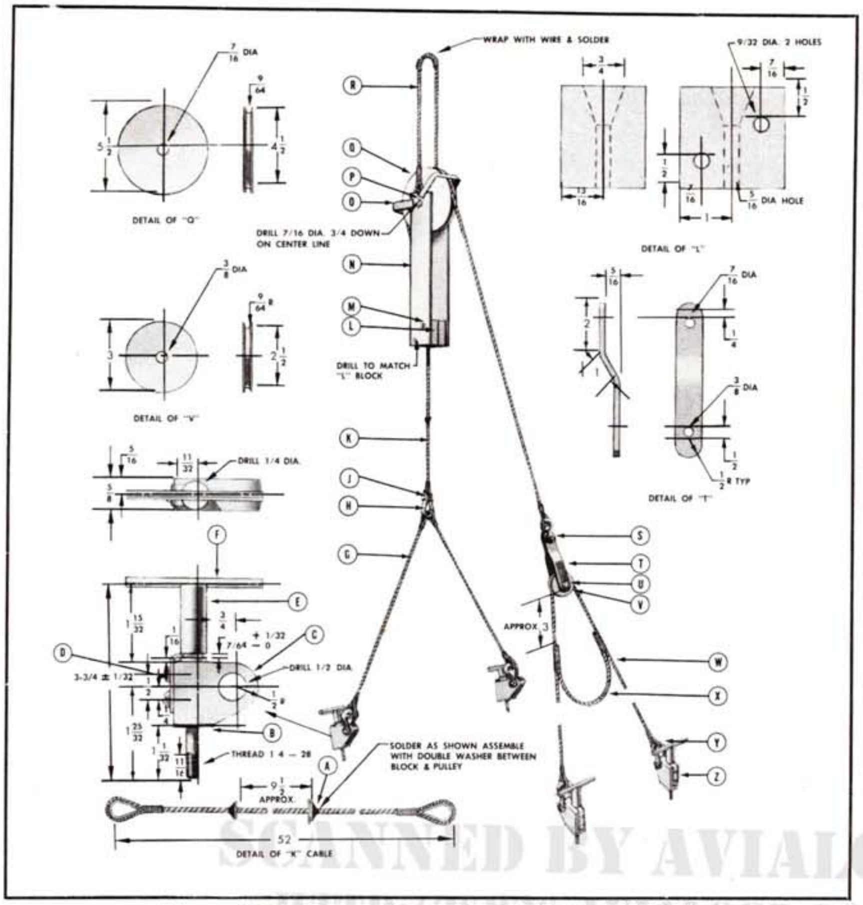

$\frac{7}{16}$ DIA
$\frac{9}{64}$
$5\frac{1}{2}$
$4\frac{1}{2}$
DETAIL OF "Q"
$\frac{3}{8}$ DIA
$\frac{9}{64}$ R
3
$2\frac{1}{2}$
DETAIL OF "V"
$\frac{5}{16}$
$\frac{11}{32}$
DRILL 1/4 DIA.
$\frac{3}{8}$
F
E
$1\frac{15}{32}$
$\frac{1}{16}$
$\frac{3}{4}$
7/64 + 1/32 − 0
C
D
3-3/4 ± 1/32
DRILL 1/2 DIA.
$\frac{1}{2}$
$\frac{1}{4}$
$\frac{1}{2}$ R
$1\frac{25}{32}$
B
$1\frac{1}{32}$
$\frac{11}{16}$
THREAD 1/4 — 28
A
$9\frac{1}{2}$ APPROX.
52
DETAIL OF "K" CABLE
WRAP WITH WIRE & SOLDER
R
O
P
O
DRILL 7/16 DIA. 3/4 DOWN ON CENTER LINE
N
M
L
DRILL TO MATCH "L" BLOCK
K
J
H
G
SOLDER AS SHOWN ASSEMBLE WITH DOUBLE WASHER BETWEEN BLOCK & PULLEY
9/32 DIA. 2 HOLES
$\frac{3}{4}$
$\frac{7}{16}$
$\frac{1}{2}$
$\frac{1}{2}$
$\frac{13}{16}$
$\frac{7}{16}$
1
$\frac{5}{16}$ DIA HOLE
DETAIL OF "L"
$\frac{5}{16}$
$\frac{7}{16}$ DIA
2
1
$\frac{1}{4}$
$\frac{3}{8}$ DIA
$\frac{1}{2}$
$\frac{1}{2}$ R TYP
DETAIL OF "T"
S
T
U
V
APPROX. 3
W
X
Y
Z

Figure 105—Outer Wing Panel Sling (K10101)

MATERIALS

Item No.	*Quantity*	*Description*
A	1	1/2 ID standard washer
	2	1/4 ID standard washer
B	1	1/16 x 5/8 x 3/4 chrome leather
C	4	5/8 x 1-1/4 x 1-5/8 SAE 1020 C.R.
D	8	10-32 x 1/4 machine screw
E	4	1/2 dia x 3-3/4 SAE 1020 H.R.
F	4	3/16 dia x 2-5/8 SAE 1020 C.R.
G	2	1/4 dia x 44 x 7 x 19 extra flexible preformed tinned aircraft cable
H	2	5/16 round pin anchor shackle
J	1	AN6-16 bolt
	1	AN310-6 nut
K	1	1/4 dia x 52 x 7 x 19 extra flexible preformed tinned aircraft cable
L	2	3/16 x 2 x 2 Masonite block
M	2	1/4-20 x 2-1/2 hex head bolt
	2	1/4 x 20 hex nut
N	2	1/4 x 2 x 12 SAE 1020 C.R.
O	2	16 gage x 3/4 x 7 SAE 1020 H.R.
P	1	AN6-25 bolt
	1	AN310-6 nut
Q	1	1/2 x 6 x 6 SAE 1020 C.R.
R	1	1/4 dia x 24 x 7 x 19 extra flexible preformed tinned aircraft cable
S	1	AN6-16 bolt
	1	AN310-6 nut
T	2	1/4 x 1 x 6-1/8 SAE 1020 C.R.
U	1	AN5-14 bolt
	1	AN310-5 nut
V	1	1/2 x 3 x 3 SAE 1020 C. R.
W	1	1/4 dia x 107 x 7 x 19 extra flexible preformed tinned aircraft cable
X	1	1/4 dia x 12 x 7 x 19 flexible cable
Y	4	3/8 round pin anchor shackle
	4	AN7-20 bolt
	4	AN310-7 nut
Z	4	3/32 x 3/8 x 1-1/4 SAE 1020 C.R.

KEY TO FIGURE 104

MATERIALS

Item No.	*Quantity*	*Description*
184	1	1/2-13 x 4 bolt, nut and washer
182	2	No. 2 x 9 sash chain
180	9	1/2 ID x 1/8 plain steel washer
178	3	5 x 6.7 No. x 56 channel
176	2	1/2 dia x 2-3/4 SAE 1020 H.R.
174	3	3/4 x 6-1/4 x 7 SAE 1020 H.R.
172	5	No. 2 x 7 sash chain
170	3	3/8 x 4 x 4-5/8 SAE 1020 H.R.
168	1	14 gage (.07) x 48 x 58 SAE 1020 H.R.
166	3	1-75-TC1 Darnell swivel caster
164	12	3/8-16 x 1/2 hex head cap screw
162	1	Weld assembly as shown
160	1	1/2-13 x 3 hex head bolt, nut and washer
158	1	Weld assembly as shown
156	1	1/2 dia x 3 SAE 1020 H.R.
154	1	1/2 dia x 5 SAE 1020 H.R.
152	3	3/4-10 hex nut and lock washer
150	1	Weld assembly as shown
148	1	1-1/2 OD x .250 wall x 19 SAE 1015 tube
146	1	1/2 x 1-1/2 x 4-1/2 SAE 1020 H.R.
144	1	1/2 dia x 1-5/8 SAE 1020 H.R.
142	1	2 OD x .250 wall x 8 SAE 1015 tube
140	1	2 OD x .250 wall x 1 SAE 1015 tube
138	1	1-1/2 OD x .250 wall x 20 SAE 1015 tube
136	2	1/4 x 1-1/2 x 1-7/8 SAE 1020 H.R.
134	1	1-1/2 dia x 7-1/2 SAE 1020 H.R.
132	3	1-1/2 dia x 3-3/8 SAE 1020 H.R.
130	3	1 nom x 19-3/4 standard black iron pipe
128	3	3/8 dia x 1-3/4 SAE 1020 H.R.
126	1	Weld assembly as shown
124	6	No. 26 gage safety spring clamp
122	2	Weld assembly as shown
120	2	Weld assembly as shown
118	1	1/2-13 x 2-1/2 hex bolt, nut and washer
116	1	2-1/2 nom x 42 std seamless black iron pipe
114	1	3 dia x 1 SAE 1020 H.R.
112	12	1/2 x 2 x 1-3/4 SAE 1020 H.R.
110	1	3 nom x 32 extra strong seamless black iron pipe
108	1	1-1/2 nom x 3-1/2 extra strong black iron pipe
106	2	1/2 x 2 x 2-1/2 SAE 1020 H.R.
104	5	1/2-13 x 4 machine bolt
102	1	1 nom x 42-1/4 extra strong black iron pipe

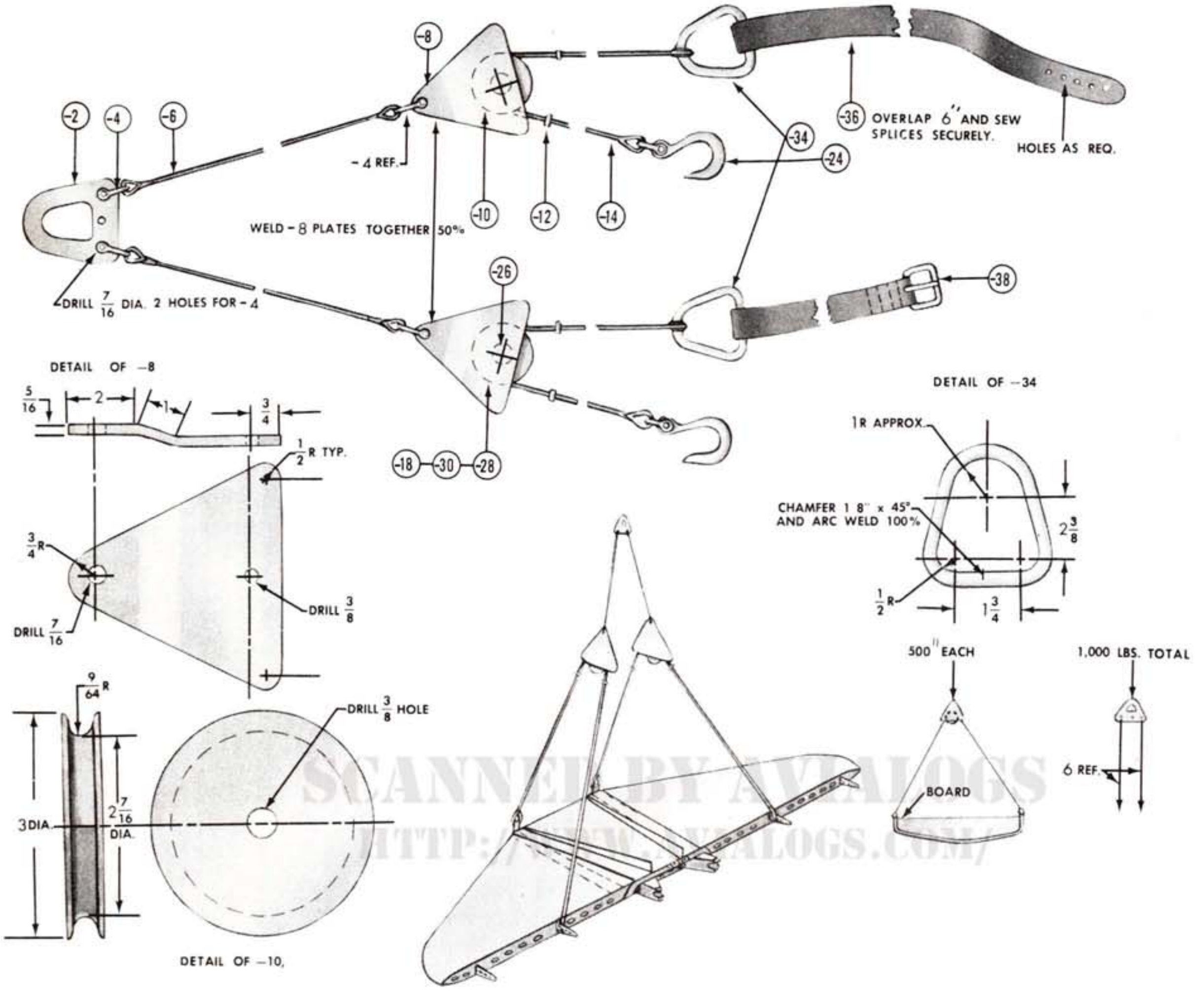

-8
-2
-4
-6
- 4 REF.
-10
-12
-14
-36 OVERLAP 6" AND SEW SPLICES SECURELY.
HOLES AS REQ.
-34
-24
WELD - 8 PLATES TOGETHER 50%
-26
-38
DRILL 7/16 DIA. 2 HOLES FOR - 4
DETAIL OF -8
5/16
2
1
3/4
1/2 R TYP.
3/4 R
DRILL 7/16
DRILL 3/8
-18
-30
-28
DETAIL OF -34
1R APPROX.
CHAMFER 1 8" x 45° AND ARC WELD 100%
2 3/8
1/2 R
1 3/4
500" EACH
1,000 LBS. TOTAL
6 REF.
BOARD
9/64 R
3DIA.
2 7/16 DIA.
DRILL 3/8 HOLE
DETAIL OF -10,

Figure 106—Horizontal Stabilizer Sling (K10801)

MANUFACTURING NOTES

1. Twelve cable clips to be adjusted by trial
2. Grind all sharp corners
3. Cover 24 with friction tape and shellac
4. Proof load as shown
5. Bend 8 while hot

MATERIALS

Item No.	*Quantity*	*Description*
38	1	No. 1B6782 1-1/2 inch harness buckle
36	2	1-1/2 type "B" Rusco webbing 120
34	2	3/8 dia x 8 SAE 1020 C.R.
30	2	AN310-6 hex. nut
28	2	AN6-14 hex. head bolt
26	4	2/16 ID x 1/16 standard washer
24	2	Hook and eye
18	2	AN380-3-3 cotter pin
14	2	3/16 6 x 19 cable 205 (with thimble)
12	4	3/16 cable clip
10	2	1/2 x 3 x 3 SAE 1020 C.R.
8	4	1/4 x 6 x 6 SAE 1020 C.R.
6	2	1/4 6 x 19 cable 78 (with thimble)
4	6	3/8 anchor round pin shackle (See figure 111.)
2	1	Hoisting link (See figure 110.)

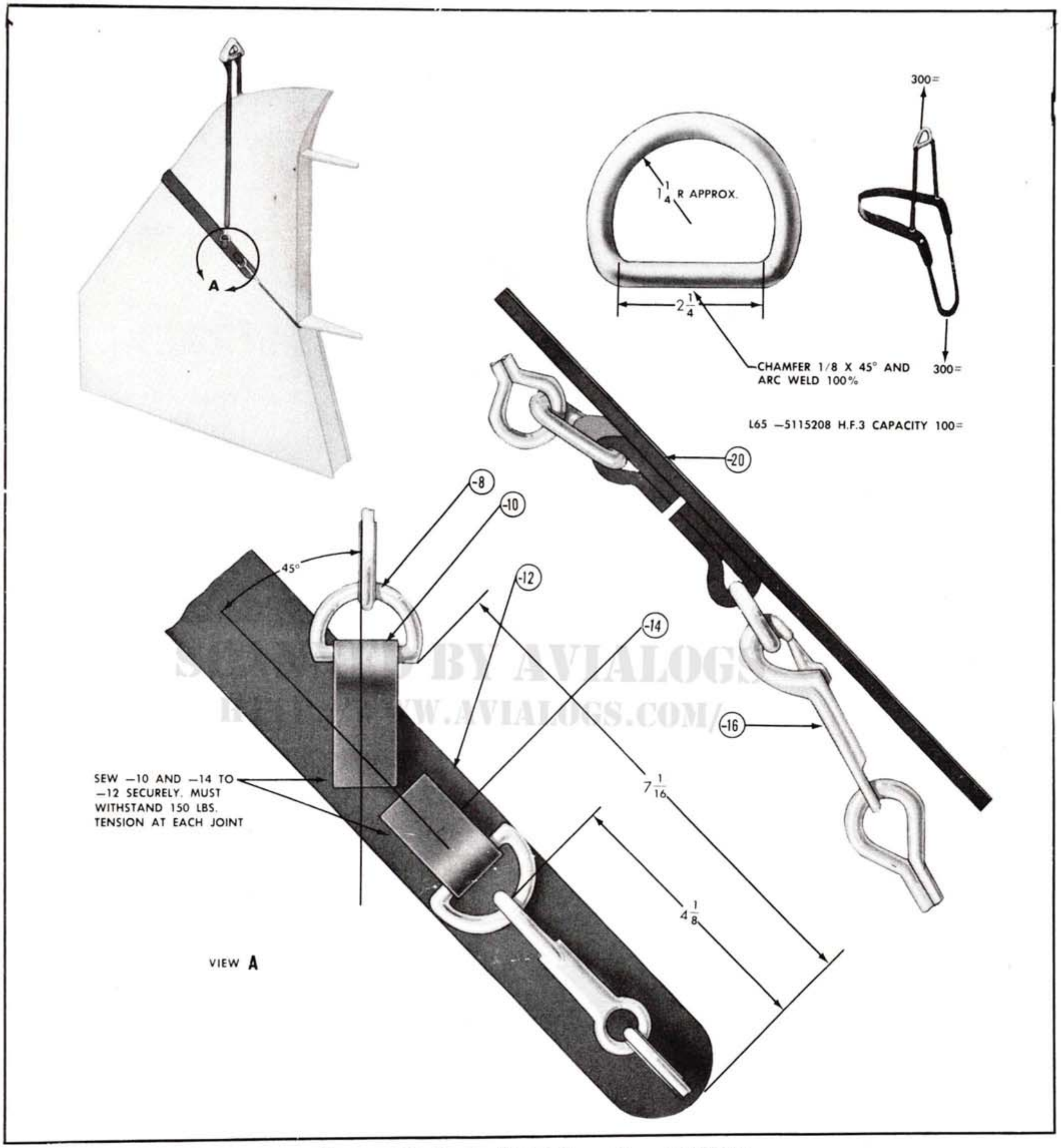

300=
1 1/4 R APPROX.
2 1/4
CHAMFER 1/8 X 45° AND ARC WELD 100%
300=
L65 —5115208 H.F.3 CAPACITY 100=
A
-20
-8
-10
-12
-14
-16
45°
7 1/16
4 1/8
SEW —10 AND —14 TO —12 SECURELY. MUST WITHSTAND 150 LBS. TENSION AT EACH JOINT
VIEW A

Figure 107—Vertical Stabilizer Sling (K10701)

MANUFACTURING NOTES

1. Wrap 8 with friction tape
2. Sew 20 to back of 12 after sewing 10 and 14 to 12

MATERIALS

Item No.	*Quantity*	*Description*
20	1	1/16 x 1-3/4 x 60 chrome leather
16	1	1/2 No. 1B6655 Trojan snap
14	2	3/16 x 2 x 3-3/4 leather
12	1	2 x 6-ply Rusco belting
10	2	3/16 x 2 x 4-1/2 leather
8	4	3/8 dia x 9 SAE 1020 C.R.

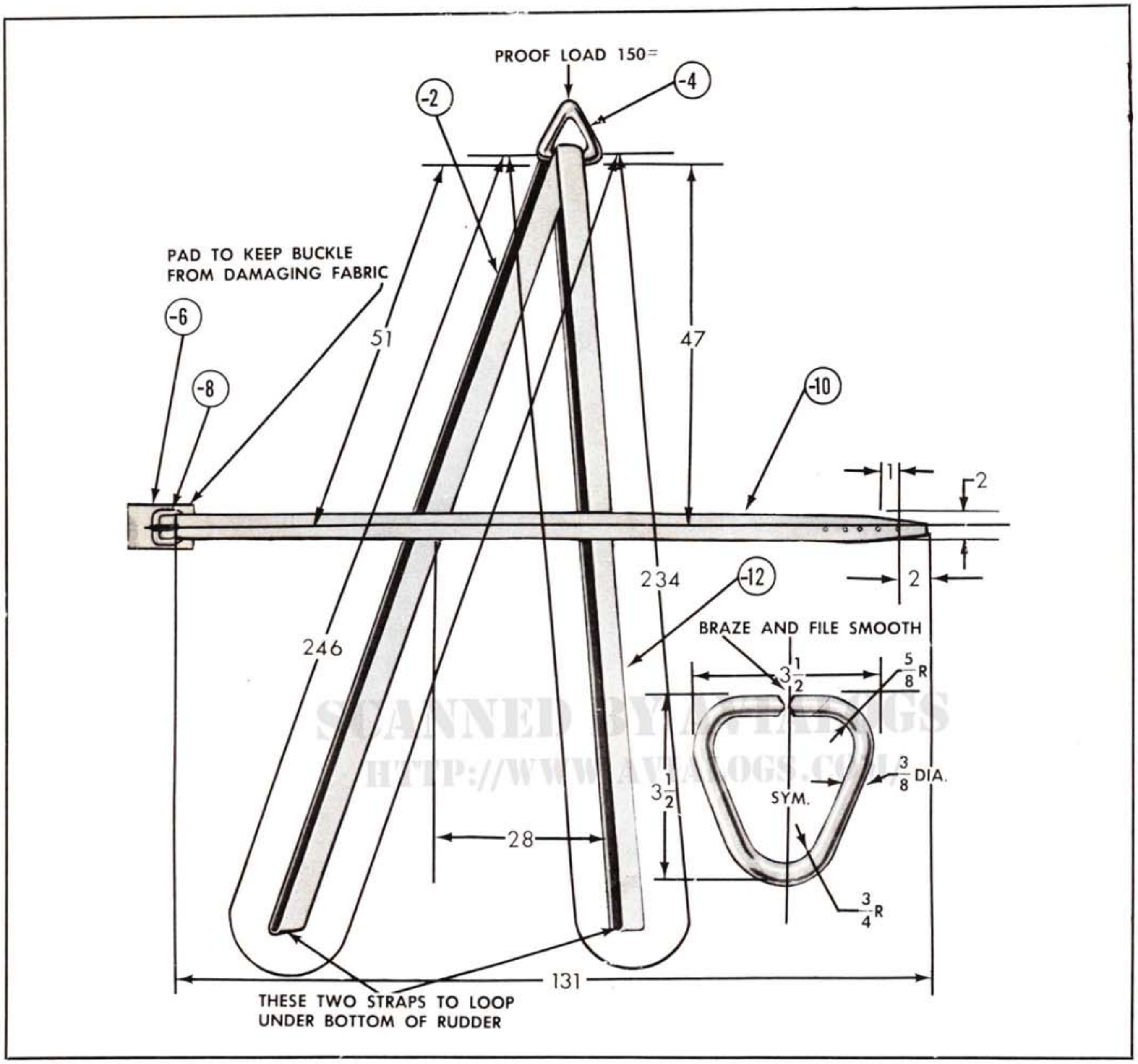

PROOF LOAD 150=
-4
-2
PAD TO KEEP BUCKLE FROM DAMAGING FABRIC
-6
-8
51
47
-10
1
2
2
234
-12
BRAZE AND FILE SMOOTH
246
$3\frac{1}{2}$
$\frac{5}{8}$ R
$\frac{3}{8}$ DIA.
SYM.
$3\frac{1}{2}$
28
$\frac{3}{4}$ R
131
THESE TWO STRAPS TO LOOP UNDER BOTTOM OF RUDDER

Figure 108—Rudder Sling (K10901)

MANUFACTURING NOTES

1. Sew ends of 2 and 12 securely
2. Sew 10 to 2 and 12 as shown

MATERIALS

Item No.	*Quantity*	*Description*
12	1	2 x 240 Rusco belting type C-6
10	1	2 x 134 Rusco belting type C-6
8	1	IB6784 2-inch harness buckle
6	1	1/4 x 3 x 6 felt and canvas pad
4	1	3/8 dia x 13 SAE 1020 C.R.
2	1	2 x 252 Rusco belting type C-6

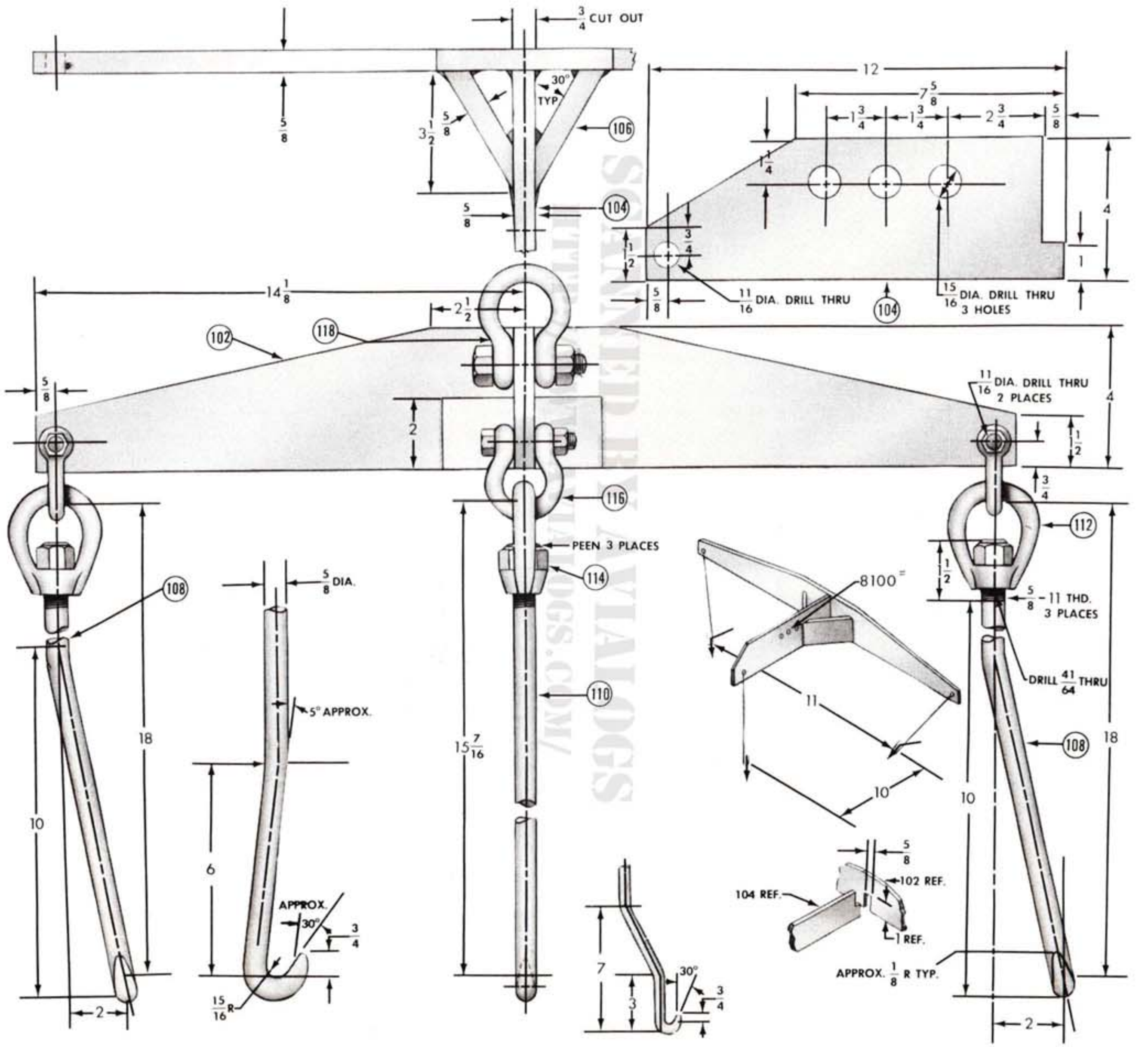
KEY TO FIGURE 109

MANUFACTURING NOTES

1. Weld 100 percent
2. Heat treat 108 and 110
   a. Rockwell C32-35
3. Break all sharp edges

MATERIALS

Item No.	*Quantity*	*Description*
118	1	3/4 anchor round pin shackle (See figure 111.)
116	3	1/2 anchor round pin shackle (See figure 111.)
114	3	5/8-11 hex. nut
112	3	No. 676 Ducommun swivel
110	1	3/8 dia x 18 NE8645 H.R.
108	2	5/8 dia x 20-1/2 NE8645 H.R.
106	2	5/8 x 2 x 4-1/4 SAE 1020 C.R.
104	1	5/8 x 4 x 12-1/8 SAE 1020 C.R.
102	1	5/8 x 4 x 28-3/8 SAE 1020 C.R.



3/4 CUT OUT
30° TYP
5/8
3 1/2
106
104
12
7 5/8
1 3/4
1 3/4
2 3/4
1 1/4
4
1
3/4
1/2
11/16 DIA. DRILL THRU
15/16 DIA. DRILL THRU 3 HOLES
14 1/8
2 1/2
102
118
2
11/16 DIA. DRILL THRU 2 PLACES
1/2
3/4
116
112
PEEN 3 PLACES
114
110
108
18
10
5/8-11 THD. 3 PLACES
DRILL 41/64 THRU
5/8 DIA.
5° APPROX.
6
APPROX. 30°
15/16 R
15 7/16
7
3
30°
8100"
11
104 REF.
102 REF.
1 REF.
APPROX. 1/8 R TYP.
2

Figure 109—Engine Sling (K13201)

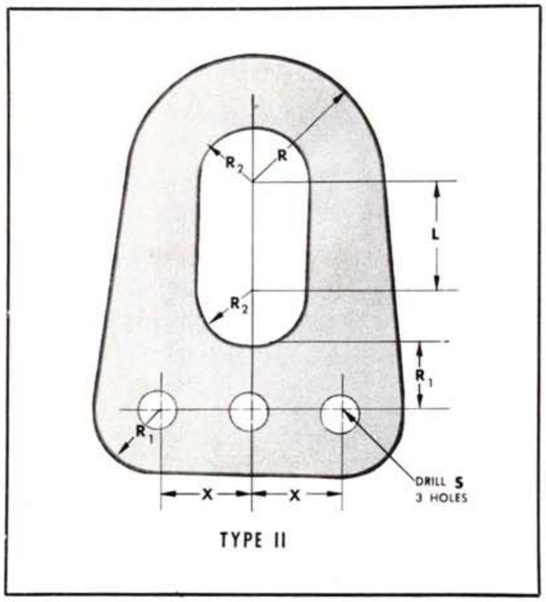


Figure 110—Hoisting Sling Link

MANUFACTURING NOTES

L	X	R	R_1	R_2	S	GAGE
2	2-11/16	2-1/2	1-3/4	1	1-3/16	1

MATERIALS

Make from SAE 1020 H.R. (gage noted).

d. ENGINE SERVICE TOOLS.—The engine special service tools in the following list are included in tool kit assembly PWA-2492 and are provided for servicing and maintaining the R-1830-92 engines in these airplanes between overhauls:

PWA-459	Depressor	— Valve spring and push rod
PWA-672	Gage	— Valve clearance
PWA-1075	Tool	— Valve adjusting screw and nut
PWA-1265	Wrench	— Oil flange
PWA-1392	Depressor	— Rocker arm
PWA-1395	Drift	— Fibre
PWA-1396	Extension	— 16-inch, ⅜-inch square
PWA-1399	Wrench	— Intake pipe nut

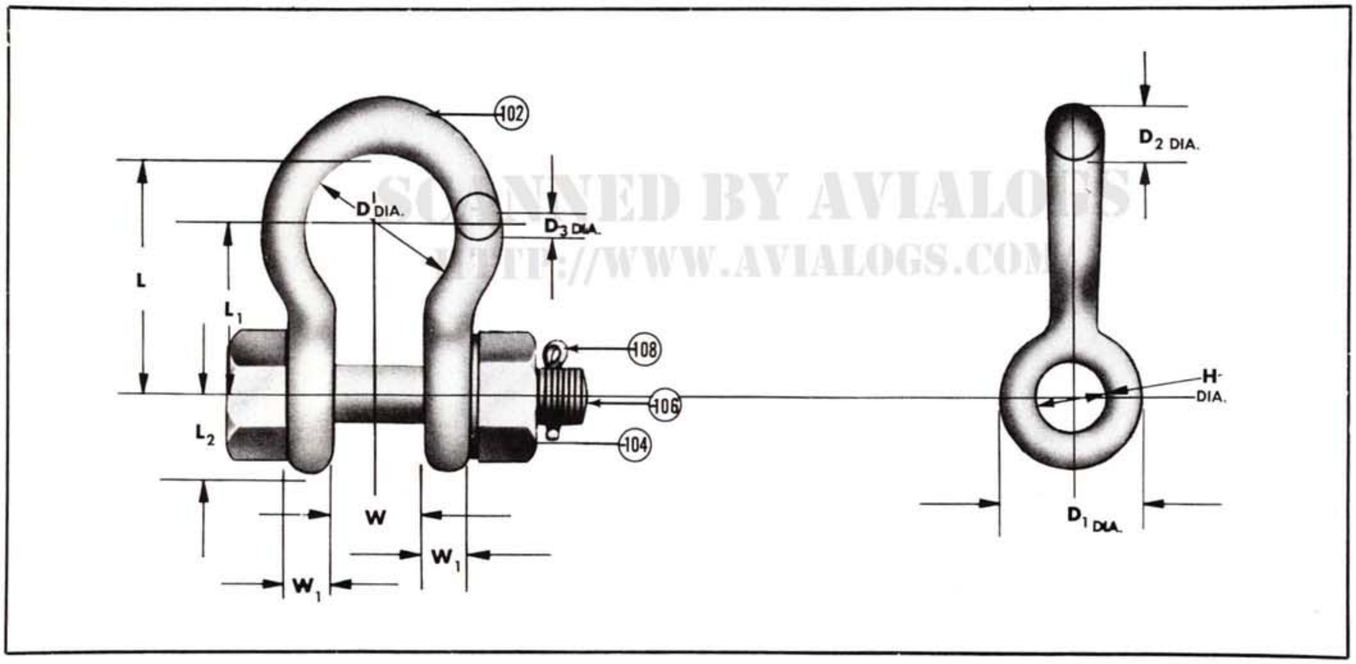


Figure 111—Sling, Clevis

MANUFACTURING NOTES

Size	*W* ±1/32	*W₁*	*L* ±1/16	*L₁* ±1/16	*L₂*	*D*	*D₁* ±1/16	*D₂*	*D₃*
3/8	11/16	3/8	1-21/32	1-3/32	35/64	1-1/8	1	27/64	3/8
1/2	13/16	1/2	2-1/4	1-17/32	11/16	1-7/16	1-1/4	9/16	1/2
3/4	1-1/4	3/4	3-7/16	2-3/8	1	2-1/8	1-7/8	27/32	3/4

H ±1/32	*Bolt Size*	*106*	*104*	*108*
1/2	7/16	7/16-14 x 2	7/16-14 Nut	1/16 x 3/4 Cotter pin
11/16	5/8	5/8-11 x 3-1/2	5/8-11 Nut	1/16 x 1 Cotter pin
15/16	7/8	7/8-9 x 4-1/4	7/8-9 Nut	1/16 x 1-1/4 Cotter pin

MATERIALS

1. 102 is an SAE 1025 drop forging
2. 104, 106, 108 as shown.

PWA-1409	Pipe	– Sump drain
PWA-1424	Wrench	– Push rod cover nut
PWA-1437	Wrench	– Box, 1⅜-inch hex.
PWA-1471	Wrench	– Starter and generator
PWA-1541	Wrench	– Spanner compensating relief valve
PWA-1608	Wrench	– Palnut, ⅜-inch
PWA-1633	Wrench	– Cylinder nut, right-hand
PWA-1634	Wrench	– Cylinder nut, left-hand
PWA-1683	Wrench	– Spark plug elbow
PWA-2210	Wrench	– Oil sump support stud
PWA-2254	Wrench	– ⅞-inch hex., spark plug
PWA-2392	Wrench	– Straightedge, timing

6. GROUND OPERATING INSTRUCTIONS.

For ground operation of engines, refer to AN 01-40NC-1, Pilot's Flight Operating Instructions for C-47, C-47A, C-47B (R4D-1, R4D-5, R4D-6) airplanes.

Remainder of this page and pages 68, 69, 70, 71, and 72 deleted in revision dated 25 February 1945.

SECTION IV

MAJOR COMPONENT PARTS AND INSTALLATIONS

Note

This section covers description, removal, disassembly, minor repair, assembly, installation, and trouble shooting of the principal component parts and systems of the airplane. Information on repairs to the airplane structure will be found in T. O. No. 01-40NC-3. Instructions for the overhaul and depot repair of engines, accessories, instruments, and other installed equipment will be found in Technical Orders specifically applicable to those items.

1. WING.

a. DESCRIPTION.—The wing is an aluminum-alloy structure consisting of a center section, to which two nacelles are permanently attached, and two outer wing panels. The center wing section is attached to the fuselage by means of eight vertical fittings. (See figure 112.) The outer wing panels are attached to the center wing section with numerous steel bolts and elastic stop nuts. A floating rib (figure 113) is placed between the center section and each outer wing panel to convey the stresses evenly. The tips of the outer wing panels are attached with machine screws.

Note

The maintenance of the ailerons, which are attached to the outer wing panels, is described in paragraph 12, this section.

(1) CENTER WING SECTION. *(See figures 114 and 115.)*—The center wing is an aluminum-alloy structure containing three main spars and an auxiliary spar. The trailing section is removable, being attached to the aft spar by means of bolts and elastic stop nuts. The nacelles, which are constructed as separate units, are bolted to the center wing. Incorporated in each nacelle structure, on the lower "hat" sections, are two rubber fittings against which the landing-gear axle rests when the landing gear is retracted. These provide a support for the landing and protect the nacelle structure when landings are made with the landing gear in the retracted position.

(2) OUTER WING PANELS. *(See figure 112.)*—The two outboard wing panels are three-spar aluminum-alloy structures. The inboard part of the trailing section is attached to the rear spar with special bolts and stop nuts on some airplanes, and on others it is riveted to the rest of the wing structure. A de-icer shoe is installed on the leading edge of each panel.

(3) WING TIPS. *(See figure 118.)*—The wing tips are all metal structures. They are attached to the outer wing panels by means of machine screws.

b. REMOVAL.

(1) OUTER WING PANELS.

(a) Remove the fairing strip which covers the wing attachment angles and bolts by detaching the hold-down clips and taking out the screws at the trailing edge fitting. (See figure 115.)

(b) Detach the small cap cover installed on the under side of the trailing edge of the wing by removing the machine screws.

(c) Working through the inboard access door (figure 8), located on the under side of the outer wing panel, disconnect the aileron control cables, and the aileron tab control cables if it is the right outer wing panel which is being removed.

CAUTION

Before disconnecting the right aileron tab cables, the tab drums, located in the control pedestal and in the outer wing panel, must be taped to prevent the cables from unwinding.

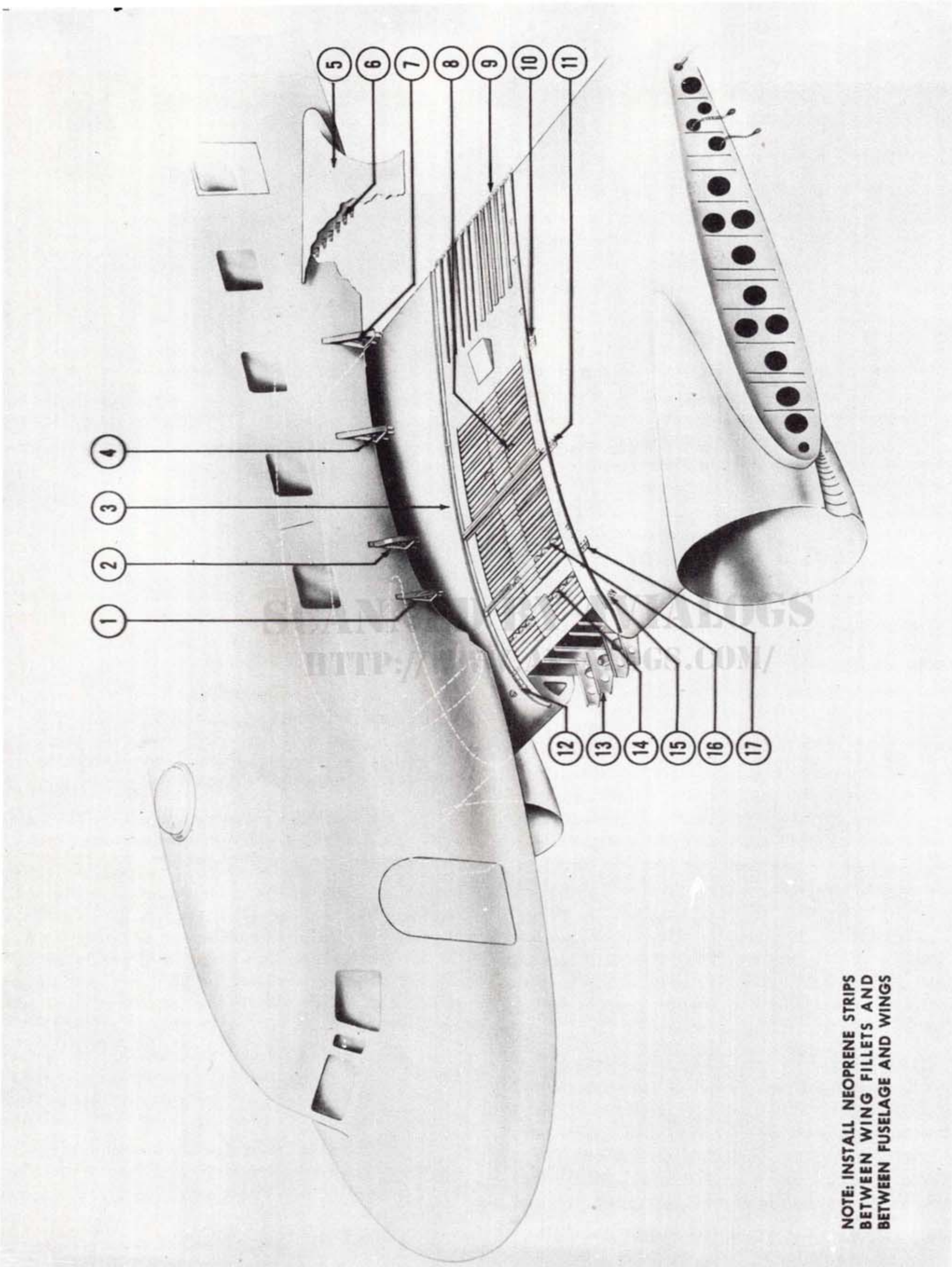
(d) Disconnect the outer wing electrical wiring at the junction box located in the wheel well.

(e) Lower the wing flaps and disconnect the flap control tube at the union outboard of the wing attaching point. (See figure 116.) It is advisable to measure the distance between the adjusting nuts on the flap control tube ends with a caliper before removing the nuts. The information will save time on the readjustment of the flaps when the tube is being reassembled.

(f) Working through the access door on the outboard side of the wheel well, disconnect the de-icer lines at the wing joint by removing the clamps from the hose.

(g) Remove the machine screws from the hoisting sling attach points in the top surface of the outer wing panel, and attach the hoisting sling. (See figure 113.)

(h) Remove the steel bolts which attach the outer wing panel to the center wing. (See figure 115.) Remove the bolts from the under surface first.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

NOTE: INSTALL NEOPRENE STRIPS
BETWEEN WING FILLETS AND
BETWEEN FUSELAGE AND WINGS

Figure 112—Center Wing Installation

KEY TO FIGURE 112

Ref	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2165838	Wing to Fuselage Attaching Bracket	2
2	2116748	Wing to Fuselage Attaching Bracket	4
3	2115673	LH Splice	1
	2115673-1	RH Splice	1
	AN3-5A	Bolt	8
	AF365-1032	Nut	8
	AN3-11A	Bolt	4
	AN3-6A	Bolt	4
4	2116748	Wing to Fuselage Attaching Bracket	4
5	5114535	LH Fillet	1
	5114535-1	RH Fillet	1
		Fiber Tape Attaching:	
	6480	Dill Lok-Scru Head and Barrel	280
	AN526-832-10	Screw	344
	AN526-832-8	Screw	4
	6481	Dill Lok-Scru Head and Barrel	58
	AN526-832-6	Screw	36
		Neoprene Strip Attaching:	
	6480	Dill Lok-Scru Head and Barrel	240
	AN526-832-10	Screw	254
	AN526-832-8	Screw	414
	6481	Dill Lok-Scru Head and Barrel	14
	AN526-832-6	Screw	36
	S-1133076-16800	Neoprene Strips	4
6	AN3-4A	Bolt	60
	AF365-D1032	Nut	60
7	2116748	Wing to Fuselage Attaching Bracket	4
8	124630-10-8	Screw	48
	AF365-DF1032	Nut	48
9	1143578	Wing to Fuselage Attachment Bolt	4
	AN310-6	Nut	12
	AN6-26	Wing to Fuselage Attachment Bolt	4
10	1116564	LH Floor Beam Attaching Fitting	1
	1116564-1	RH Floor Beam Attaching Fitting	1
	AN23-17A	Bolt	4
	AF365-1032	Nut	4
11	1143578	Wing to Fuselage Attachment Bolt	8
	AN310-6	Nut	16
12	2116076	LH Splice Angle	1
	2116076-1	RH Splice Angle	1
	AN3-5A	Bolt	16
	AF365-1032	Nut	16
	132100-3-5A	Bolt	16
13	4115667	LH Bracket	1
	4115667-1	RH Bracket	1
	4115937	LH Bracket	1
	4115937-1	RH Bracket	1
	AN520-10-8	Screw	36
	AF365-D1032	Nut	36
14	1116570	Fitting	6
	AN23-15A	Bolt	12
	AF365-1032	Nut	12
15	AN5-21	Wing to Fuselage Attachment Bolt	4
	AN310-5	Nut	4
16	1116571	Fitting	4
	AN23-16A	Bolt	8
	AF365-1032	Nut	8
	1114106	Fitting	2
	AN502-416-22	Screw	2
	AF365-428	Nut	2
17	1143578	Wing to Fuselage Attachment Bolt	8
	AN310-6	Nut	16

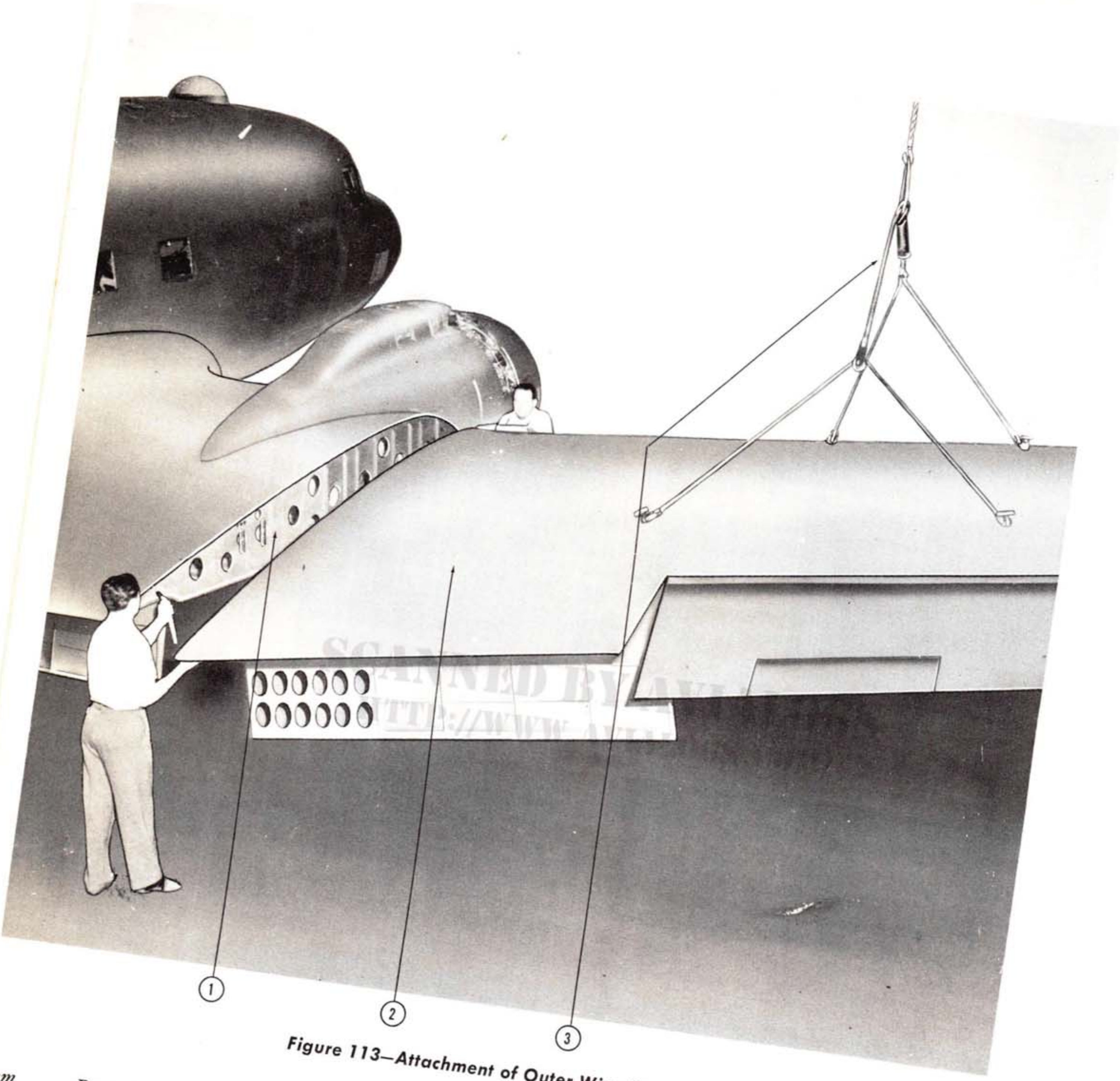


Figure 113—Attachment of Outer Wing Panel

em	Part No.	Part Name	No. Req Per Apl
	5115913-1	RH Rib Assembly (false rib)	1
	5115913	LH Rib Assembly (false rib)	1
	5110587-1	RH Outer Wing Assembly on C-47	1
	5110587	LH Outer Wing Assembly on C-47	1
	5141402-1	RH Outer Wing Assembly on C-47A	1
	5141402	LH Outer Wing Assembly on C-47A	1
	5115201-1	RH Wing Tip Assembly	1
	5115201	LH Wing Tip Assembly	1
	K10101	Outer Wing Panel Sling	

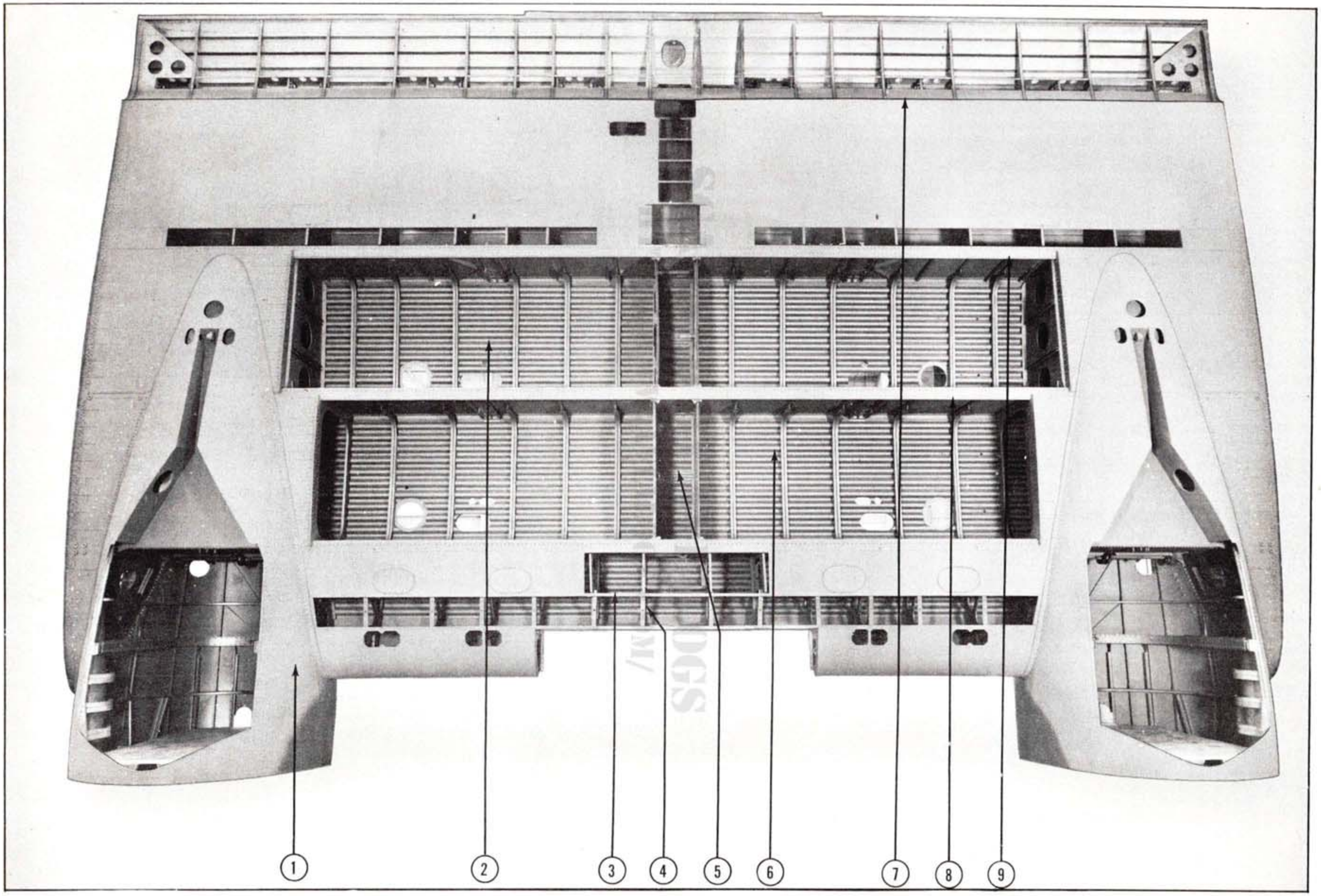


Figure 114—Center Wing—Bottom View

1. Nacelle Assembly
2. Auxiliary Fuel Tank Bays (Left and Right)
3. Auxiliary Spar
4. Ribs
5. Control Tunnel
6. Main Fuel Tank Bays (Left and Right)
7. Trailing Section
8. Front Spar
9. Center Spar

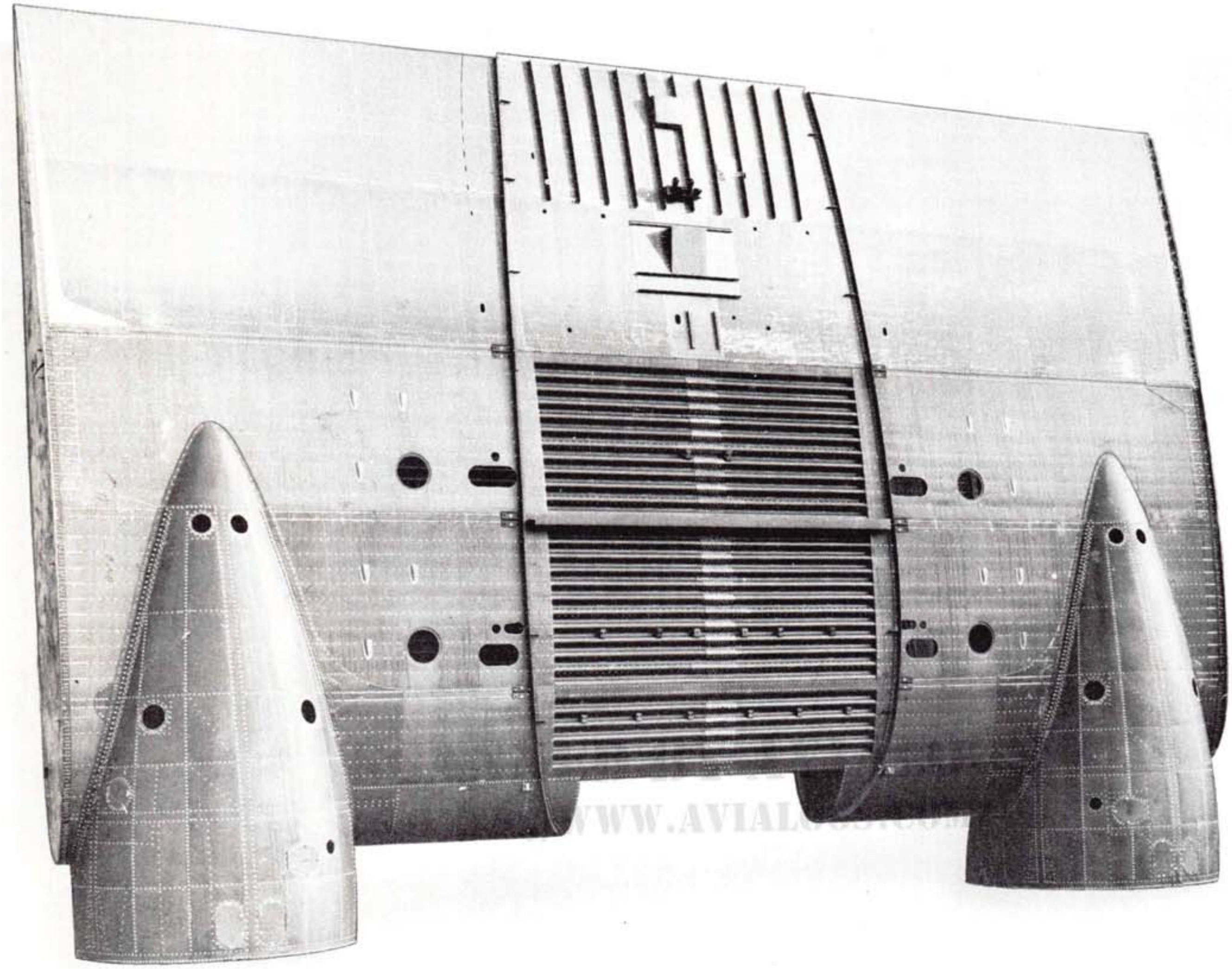


Figure 115—Center Wing—Top View

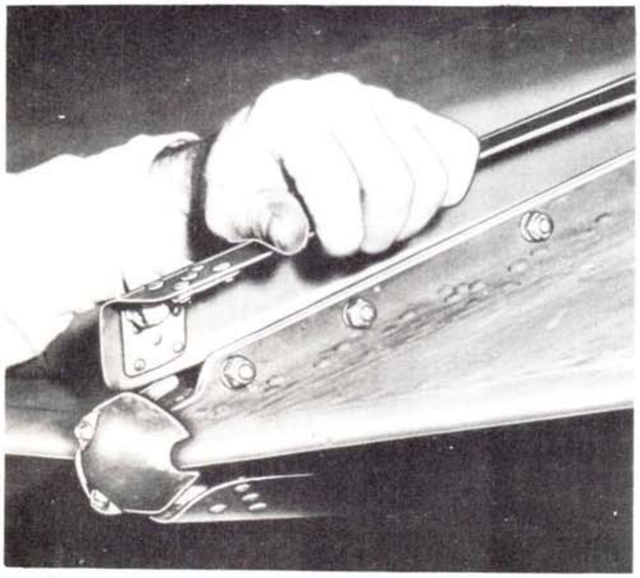


Figure 116—Removal of Outboard Wing Fairing

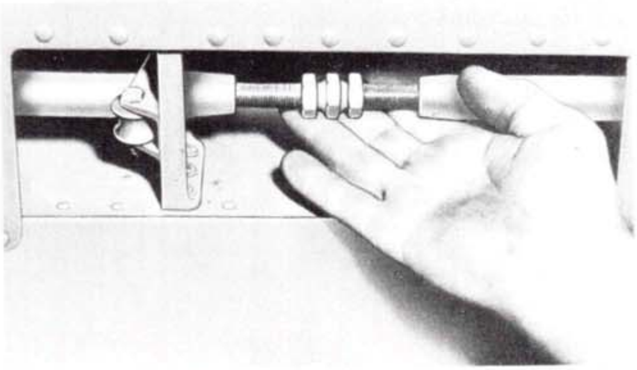


Figure 117—Wing Flap Operating Tube Union

(i) Lift the outer wing panel clear of the center wing (figure 113) after making certain that all lines, cables, and wires have been disconnected.

(2) WING TIP.

(a) Remove the aileron, as described in paragraph 12.*b*(1)*(b)*, this section.

(b) Remove the length of fairing which secures the de-icer shoe to the wing tip.

(c) Peel the de-icer shoe back past the point where the wing tip is attached to the wing.

(d) Remove the inspection plate from the under side of the wing tip and disconnect the wing tip electrical wiring in the junction box.

(e) Remove the machine screws which attach the wing tip section to the wing outer panel. Remove the screws from the lower surface first, and support the tip section while removing the top side screws.

(f) Pull the wing tip outward until it is free of the wing outer panel. Two men are required.

(3) CENTER WING.

(a) Remove both outer wing panels, as described in paragraph 1.*b.*(1), this section.

(b) Remove the fuel tanks, as described **in paragraph** 10.*b.*(2)*(a)*, and 10.*b.*(2)*(b)*, **this section.**

(c) Remove both engines, as described in paragraph 6.*b.*(1)*(b)*, this section.

(d) Hoist the entire airplane by means of the nacelle hoists and the rear fuselage hoist.

(e) Remove the landing gear, as described in paragraph 4.*b.*(1)*(b)*, this section.

(f) Remove all fillets and neoprene strips installed between the wing and the fuselage by taking out the machine screws. Then remove lower pan at the junction of the leading edge of the wing and the fuselage.

(g) Attach the front fuselage hoist to the hoist fitting at the auxiliary post.

(h) Remove the fuselage floor panels which are located over the wing.

(i) Remove the two forward and two aft oxygen cylinders, if installed in the airplane. This is necessary to provide access to flight control cable turnbuckles and to the screws which attach the trailing edge of the wing to the fuselage skin. Refer to paragraph 20.*c.*(2)*(e)*, section IV.

(j) Remove the bolts which attach the two fuselage floor beams to the wing.

(k) Disconnect all lines at the unions provided at the intersection of the fuselage and wing tunnels.

(l) Disconnect all surface control cables at the turnbuckles located under the companionway floor. Pull the empennage control cables out of the wing, and the aileron control cables out of the fuselage.

(m) Disconnect the empennage de-icer lines at the "Y," located in the fuselage forward of the center wing and on the top side of the center wing (station 312½).

Note

Station numbers may be found by referring to the stations diagram, figure 5.

(n) Remove the four clips which support the de-icer lines "Y" on the floor beam at station 195½.

(o) Detach the wobble pump operating shaft at the pumps and under the companionway floor. Then disconnect the joint in the shaft and remove the pumps by detaching the supporting panel.

(p) Remove the wing flap indicator control wire from the wing by removing the clevis located at the wing flap actuating strut cylinder. Pull the wire out of the center wing.

(q) To disconnect electrical wires at the junction of the center wing and the fuselage, it will be necessary to remove the plugs located in the leading edge of the center section wing. Then disconnect the two starter wires and the flexible conduit within the junction box located on the forward wing spar.

(r) Disconnect the electrical wires leading from the fuselage to the center wing section at the junction box located on the top side of the center wing section beween stations 294½ and 312½.

(s) Free the parapack supporting rods by removing the bolts from the four brackets.

(t) Disconnect the parapack control cable conduits by removing the two Adel clips at station 351½.

(u) Remove the screws which attach the wing trailing edge to the fuselage skin.

(v) Remove the bolts which attach the fuselage longitudinal bulb angles in the trailing edge of the wing.

(w) Remove all screws which attach the fuselage frames to the upper surface and leading edge of the wing.

(x) Remove the screws from the four intercostal brackets, which tie the lower nose and the center wing and remove the brackets.

(y) Remove the screws which attach the fuselage longitudinals to the leading edge of the wing.

(z) Remove the bolts which attach the lower fuselage surface to the center wing attach angles.

(aa) Remove the fuel vent line supporting clips on the right and left side of the fuselage above the wing.

(ab) Remove the screws from the aft end of the heat mixing chambers located in the fuselage forward of the leading edge of the center wing, on the right and left sides. Also remove the screws from the floor beam deflection angle which attaches the floor beam to the front wing spar.

(ac) From the top side of the center wing, at station 202½, remove the clips which support the heating unit control lines.

(ad) Remove the bolts from the fittings which attach the wing spars to the fuselage.

(ae) Check to see that no connections have been overlooked and that the wing is free.

(af) Lift the fuselage away from the center wing.

c. MAINTENANCE REPAIR.

(1) For instructions on the repair of the wing structure, refer to T. O. No. 01-40NC-3, handbook of structural repair instructions for these airplanes.

(2) An access door may be installed on the under side of the outer wing panel in certain specified areas if internal access should be necessary. Instructions on the installation will be found in T. O. No. 01-40NC-3.

(3) Replace worn or broken bushings.

d. ASSEMBLY AND INSTALLATION.

(1) OUTER WING PANEL.—Reverse the removal procedure, making certain that the floating or false ribs, and the rubber bumpers on the spars, are installed. This is very important as correct stress distribution is obtained only when they are in place. Great care also should be taken when installing the attachment bolts. Bolts should be installed at the spars first, both top and bottom, and all bolts should be tightened gradually in sequence around the wing so that no one area will be forced into position before the other areas are drawn into position. A torque wrench should be used to tighten the nuts to a torque value of 100 inch-pounds. (Zinc finish nuts are identified by a dull silver color and cronak finish nuts by a bronze color.) If a torque wrench is not available, the nuts should be tightened with an end wrench which is not more than 5½ inches long. This limitation of leverage lessens the possibility that a bolt will be tightened until it yields and thus becomes useless. Bolts must be absolutely free of grease or oil when installed and cadmium-plated steel washers should be used. The elastic stop nuts may be re-used so long as it requires 4 pounds of torque to turn a nut up until the time it starts taking a structural load. In other words, there must still be enough uncut fiber in the elastic stop nut to make the self-locking feature function properly.

(2) CENTER WING.—To install the center wing, reverse the removal procedure. The bolts which attach the forward, center, and rear wing spar fittings to the fuselage should be tightened to a torque 175 + 100, —0 inch-pounds. There is no special torque requirement for the bolt which attaches the auxiliary spar fitting to the fuselage.

(3) WING TIP.

(a) To install the wing tip, reverse the removal procedure.

(b) To install wing tips not drilled for attachment, proceed as follows:

1. Remove aileron by removing the attaching bolts from the hinge brackets (DO NOT TAMPER WITH RIGGING).

a. Remove de-icer shoe fairings.

b. Remove the de-icer shoe enough to permit removal of the damaged wing tip. Care should be taken when peeling the shoe to avoid tearing it.

c. Remove the screws from the inspection plate and disconnect the electrical wiring in the junction box in the wing tip.

d. Place a suitable stand under the damaged wing tip and remove the bolts from the top and the bottom of the wing at the splice of the wing and wing tip. Save all attach bolts which are removed, as they must be used for installing the new wing tip.

e. Slip the damaged wing tip off the wing.

2. Use a 90-degree square on the outer wing stub and with a pencil, draw a line from the center of each attach hole on to the skin of the wing, as shown in A, figure 118. Do not use a scribe.

3. Slip the new undrilled wing tip on to the outer wing. Place two 10-foot straightedges over the wing and tip as shown in B, figure 118. Run a string through the aileron hinge holes. Tie the string at the hinge farthest inboard on the wing so that it passes through the hinge hole in this bracket. The straightedges must lie flat on the surface of the wing and wing tip, and the string should be pulled taut and float through all the hinge holes. This will indicate that the hinges are in perfect alignment.

Note

When matching the wing tip in this way, it may be necessary to trim either the top or the bottom of the inboard edge of the wing tip to allow for proper alignment of wing and wing tip.

4. After the wing tip is correctly located, place a ruler along the lines on the wing and extend the line onto the wing tip, as shown in B, figure 118. After all location lines have been transferred from the wing to the tip, remove the tip from the wing.

5. Determine the distance the center points of the holes in the attach flange are from the skin of the wing as shown in C, figure 118.

6. Transfer the measurement determined above to the wing tip as shown in C, figure 118.

7. With the center lines of all the holes determined as indicated above, drill all the holes in the tip with a No. 10 (.193-inch diameter) drill.

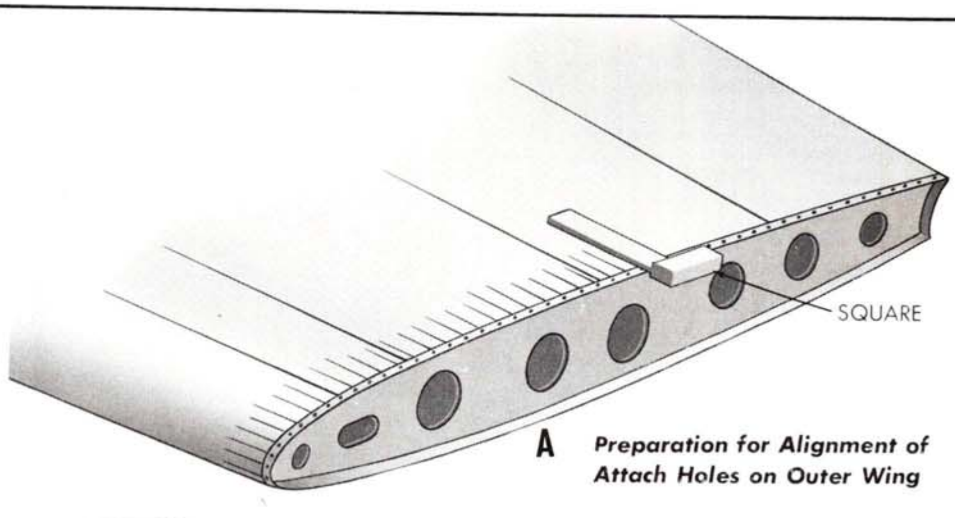
8. Attach the new tip to the wing with the same screws previously used. It is imperative that steel screws be used to attach the tip to the wing.

9. Connect the electrical wires and reinstall the de-icer shoes by reversing the removal procedure.

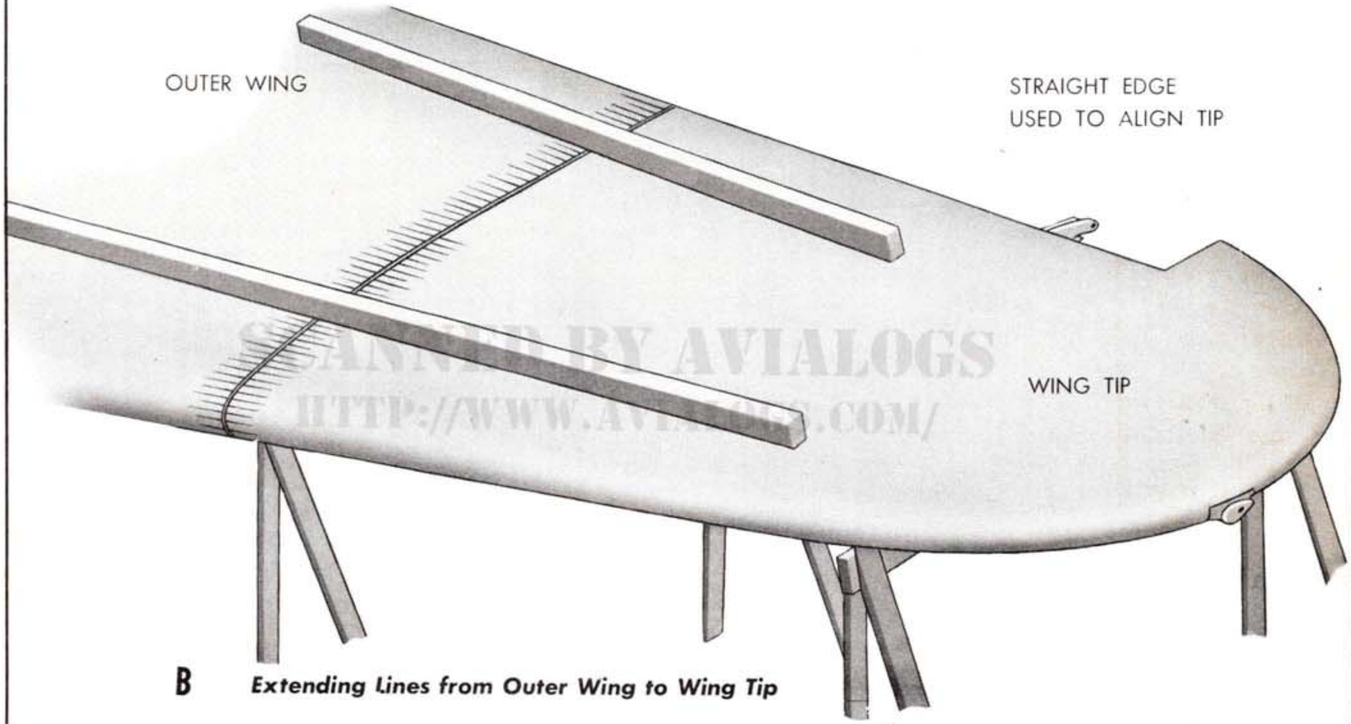
(c) To install wing tips which have not been correctly drilled, proceed as follows:

Note

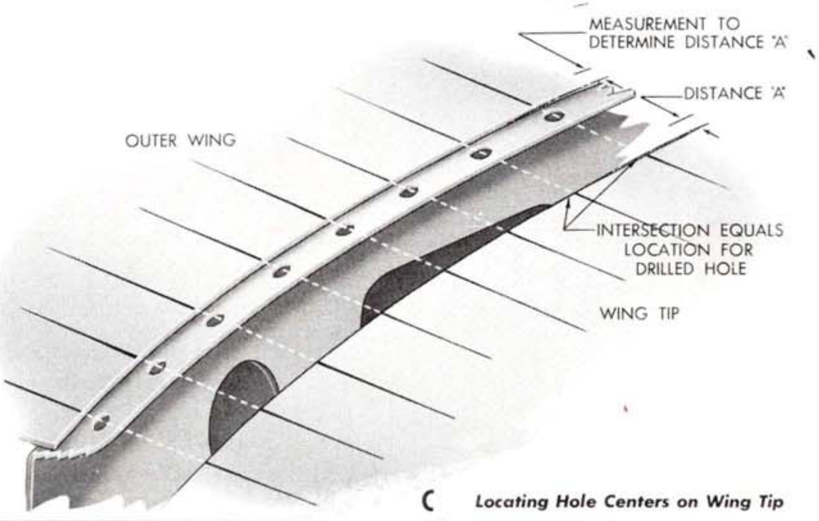
This method may be used when spare wing tips are delivered predrilled, or when it is desirable to install wing tips exchanged from one airplane to another. Some predrilled wing tips will fit the outer wing stub, and therefore, before any rework is accomplished on the wing stub, the spare wing tip to be attached



A ***Preparation for Alignment of Attach Holes on Outer Wing***


OUTER WING
STRAIGHT EDGE USED TO ALIGN TIP
WING TIP

B ***Extending Lines from Outer Wing to Wing Tip***


MEASUREMENT TO DETERMINE DISTANCE 'A'
DISTANCE 'A'
OUTER WING
INTERSECTION EQUALS LOCATION FOR DRILLED HOLE
WING TIP

C ***Locating Hole Centers on Wing Tip***

Figure 118—Installation of Undrilled Wing Tips

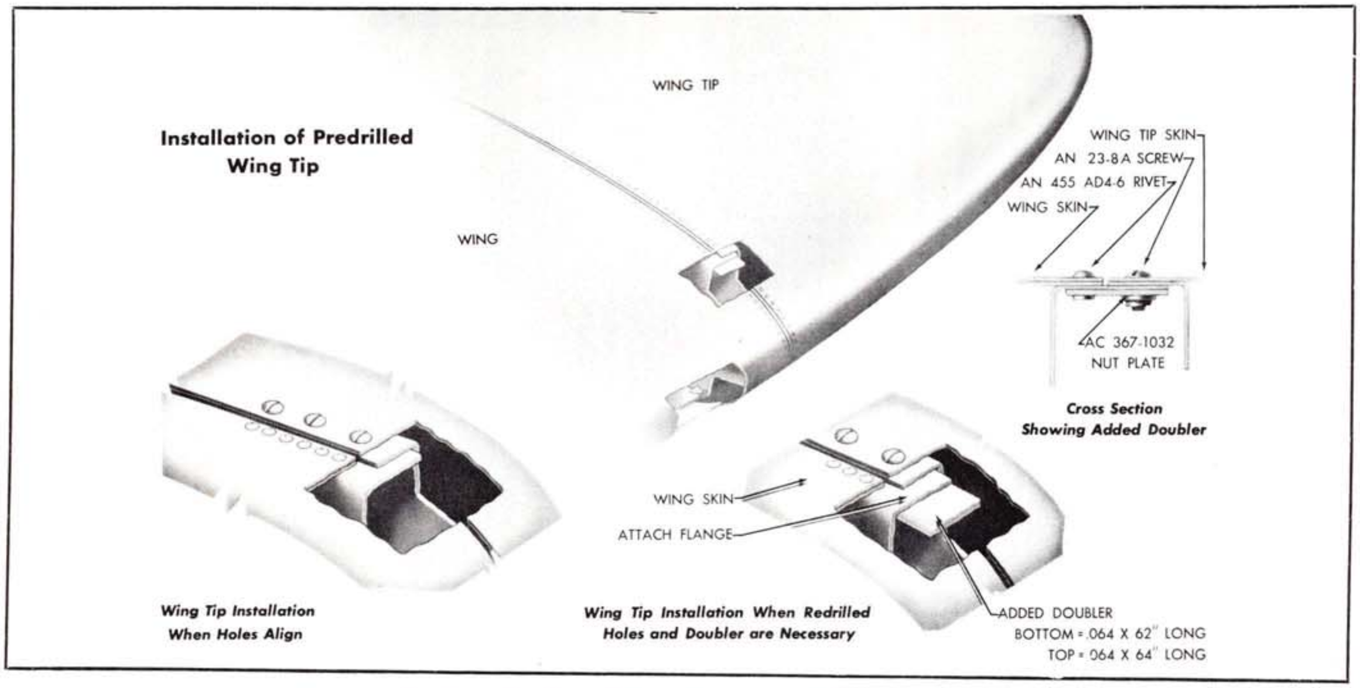

Installation of Predrilled Wing Tip
WING TIP
WING
WING TIP SKIN
AN 23-8A SCREW
AN 455 AD4-6 RIVET
WING SKIN
AC 367-1032 NUT PLATE
Cross Section Showing Added Doubler
WING SKIN
ATTACH FLANGE
ADDED DOUBLER
BOTTOM = .064 X 62" LONG
TOP = .064 X 64" LONG
Wing Tip Installation When Holes Align
Wing Tip Installation When Redrilled Holes and Doubler are Necessary

Figure 119—Installation of Predrilled Wing Tips

KEY TO FIGURE 120

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	3115125	Rudder Hinge	1
	AN4-10A	Bolt (Hinge Attach.)	4
	AF365-428	Nut	4
	134808	Eyebolt	1
	AN310-6	Nut	1
	AN4-12	Bolt (Attach. Eyebolt to Hinge)	1
	AN310-4	Nut	1
2	3115125	Rudder Hinge	1
	AN4-10A	Bolt (Hinge Attach.)	2
	AN4-7A	Bolt (Hinge Attach.)	2
	AF365-428	Nut	4
	134808	Eyebolt	1
	AN310-6	Nut	1
	AN4-12	Bolt (Attach. Eyebolt to Hinge)	1
	AN310-4	Nut	1
3	5115208-2	Vertical Stabilizer Tip	1
	124630-8-7	Screw (Tip Attach.)	34
4	5115208	Vertical Stabilizer Assembly Complete	1
5	2-364-5-1	Goodrich De-Icer Shoe	Ref
6	AN526-1032-14	Screw (Stabilizer Attach.)	2
	AN526-1032-12	Screw (Stabilizer Attach.)	28
	AN526-1032-10	Screw (Stabilizer Attach.)	114
	AN526-1032-8	Screw (Stabilizer Attach.)	26
7	AN3-4	Bolt (Vertical Stabilizer Attach.)	4 or 5
	AN310-3	Nut	4 or 5
8	AN3-5A	Bolt (Attach. Horizontal Stabilizer to Fuselage)	100
	AF365-1032	Nut	100
	AN-4A	Bolt (Attach. Rear End of Stabilizer to Fuselage Channels)	8
	AF365-428	Nut	8
	AN4-5A	Bolt (Attach. Angles to Stabilizer)	6
	AF365-1032	Nut	6
9	3115184-1	Outer Elevator Hinge	2
	AN4-11A	Bolt	2
	AF365-428	Nut	4

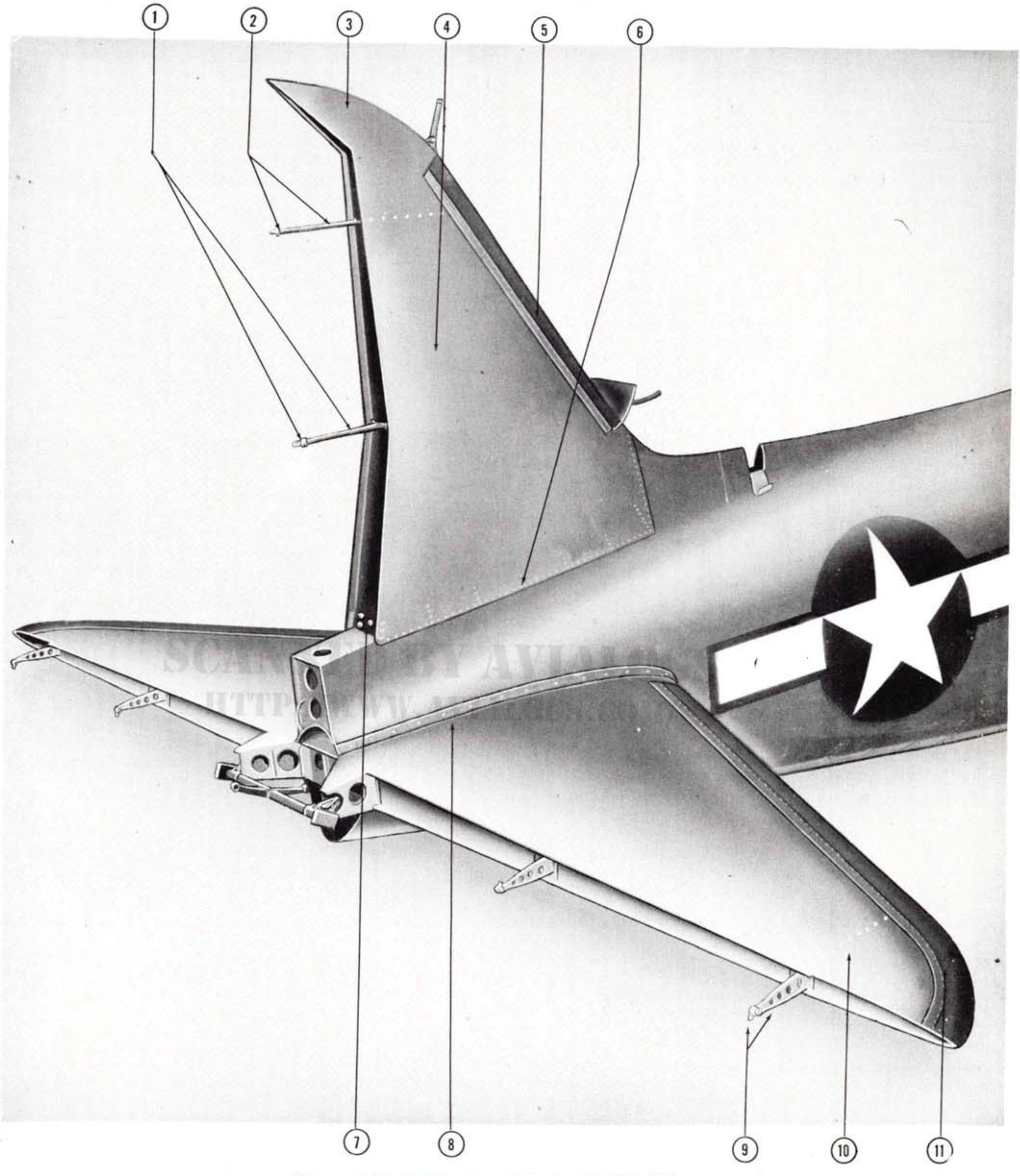


Figure 120—Vertical and Horizontal Stabilizers

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
	AN4-6A	Bolt	2
	3115184	Inner Elevator Hinge	2
	AN4-6A	Bolt	2
	AF365-428	Nut	4
	AN4-11A	Bolt	2
10	5115183	Horizontal Stabilizer Tip Assembly	1
11	2-364-4-1	Goodrich De-Icer Shoe	2

should be installed on the stub, and the alignment of holes determined. If all the holes align, and it is apparent that no rework is necessary, install the wing tip. However, if it is evident that holes in the wing stub do not align with those in the wing tip, the following rework should be accomplished to correctly install the wing tip. No attempt should be made to elongate attach holes in the wing tip to accommodate slightly off-center nut plates because this will greatly weaken the resultant wing structure.

1. Remove the damaged wing tip, as directed in paragraph 1.*b*.(2), this section.

2. Remove all the nut plates from the attach angle on the stub of the outer wing by drilling out the rivets.

3. Drill out the rivets which attach the outer skin to the attach flange.

4. Install doubler under upper attach flange.

a. Place the 64-inch .064 steel doubler under the attach flange on the outer wing stub as shown in figure 119. Bend and bevel it to fit. Start the center of the doubler and drill through the holes created in step 3 preceding, and through the steel doubler. Use a No. 30 (.128-inch diameter) drill.

b. Drill six holes near the center of the doubler and attach the doubler to the attach flange and skin of the wing with AN455-AD4-6 rivets.

c. With the doubler so located, drill the rest of the holes through the doubler using the holes created in step 3 above as guides, and install the rest of the rivets. Always work from the center of the doubler to either end.

5. Install doubler for lower attach angle. Use the procedure outlined in step 4 preceding, and install the 62-inch doubler on the lower attach flange of the outer wing stub after all the nut plates and rivets have been removed.

6. Locate attach holes in doubler.

a. With both doublers installed, place the drilled wing tip over the reinforced attach flange and by some external means of support, hold it securely in its proper place. Align the wing tip with a straightedge and string as indicated in paragraph 1.*d*.(3)*(b)*3., this section.

b. Use the attach holes in the wing tip as a guide and drill the required number of No. 10 (.193-inch diameter) holes through the reinforced attach angles on the outer wing stub.

7. Install nut plates for attach screws.

a. After all the holes have been drilled, remove the wing tip from the outer wing stub.

b. Insert the attach screws through the holes drilled in the reinforced attach flange and temporarily attach a nut plate to each screw. Locate the nut plates on the inside of the attach flange in a position similar to that of the old nut plate installation.

c. When all the nut plates have been located as directed, drill two No. 40 (.098-inch diameter) holes through each of the attach holes in the nut plate through the attach flange and doubler. Attach the nut plates to the reinforced doubler with AN325AD3-6 rivets.

d. After all the nut plates have been installed, remove the screws from the nut plates.

8. Install the wing tip.

a. Again place the new wing tip over the reinforced flange on the end of the stub. Attach the wing tip to the outer wing with AN23-8A screws.

b. Before removing the wing tip support, make certain that all the attaching screws are firmly installed.

c. Connect the electrical circuit and de-icer shoe.

2. EMPENNAGE.

a. DESCRIPTION.—The empennage consists of the vertical and horizontal stabilizers (figure 120), the elevators, and the rudder. Information about the elevators and the rudder is given in paragraph 12, this section.

(1) HORIZONTAL STABILIZER. *(See figures 120 and 121.)*—The horizontal stabilizer is an aluminum-alloy structure consisting of two interchangeable halves. The two parts are bolted together, but for the purpose of removal and installation, they may be considered as a single unit. Each of the parts has a removable tip. A de-icer shoe is installed on the leading edge of each part. The horizontal stabilizer is attached to the fuselage by bolts which are inserted through flange plates riveted to the stabilizer. Four hinge brackets are bolted to the stabilizer ribs for attachment of the elevators.

(2) VERTICAL STABILIZER. *(See figures 120 and 122.)*—The vertical stabilizer is an aluminum-alloy structure with a removable tip. A de-icer shoe is installed on the leading edge. The sides of the stabilizer are attached to the fuselage with machine screws which are turned into nut plates riveted to the fuselage. The base of the aft end of the stabilizer is bolted to the fuselage. Two hinge fittings are bolted to the structure for attachment of the rudder. Two lugs for the attachment of radio antennas are provided on the leading edge of the stabilizer tip.

b. REMOVAL.

(1) HORIZONTAL STABILIZER.

(a) No fuselage hoist, jack or other special support is required for the removal of the horizontal stabilizer.

(b) Disconnect the tail lamp wires at the junction box in the tail cone, working through the access door on the left side of the cone.

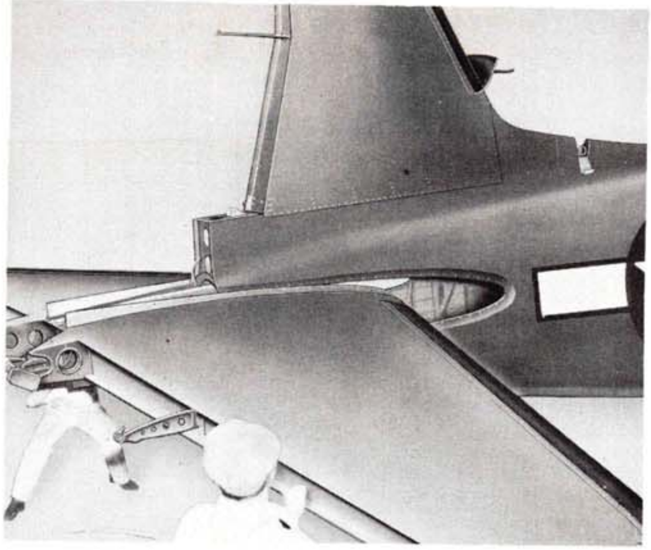


Figure 121—Installation of Horizontal Stabilizers

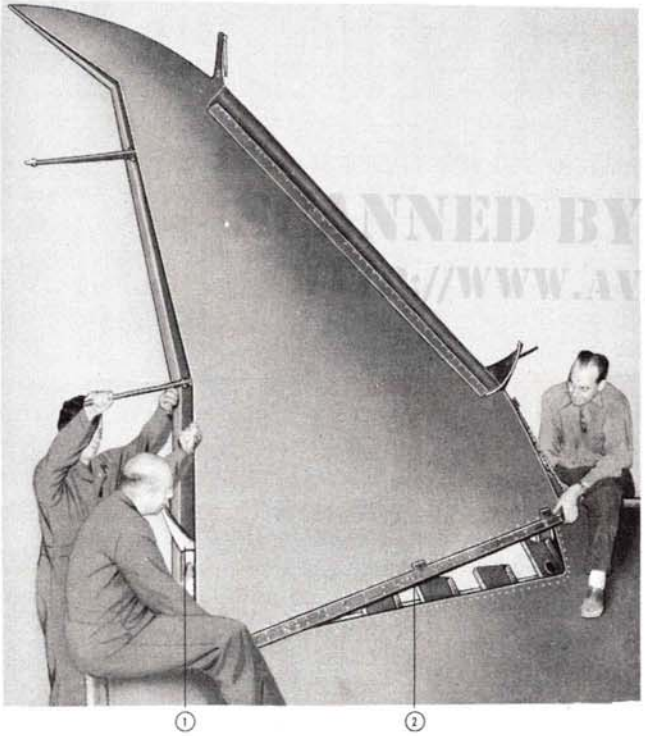


Figure 122—Installation of Vertical Stabilizers

1. Cloth Weather Cover
2. Special "Shoe-horn" Jig Used in Factory Installation.

(c) Remove the tail cone by detaching the machine screws which attach it to the fuselage.

(d) Remove the elevators as described in paragraph 12. *b.* (2) *(b),* this section.

(e) Detach the rudder stop cable assembly by removing the bolt from the bracket (figure 123) attached to the top surface of the horizontal stabilizer in the fuselage aft section.

(f) Disconnect the elevator control cables at the elevator horns.

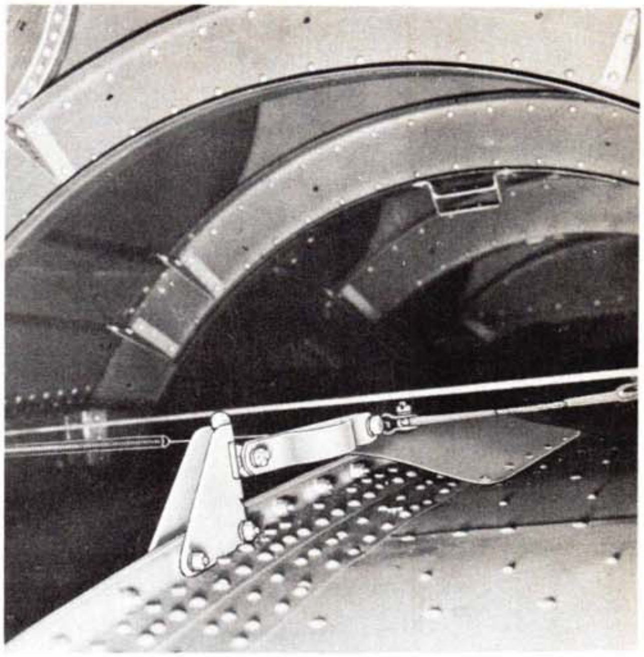


Figure 123—Rudder Stop Cable Attachment

(g) Detach the glider tow release cable at the turnbuckle in the fuselage aft section

(h) Detach the fuselage to stabilizer fillets by removing the screws.

(i) Detach the de-icer line leading to each stabilizer.

(j) Remove the bolts which attach the stabilizer to the fuselage.

(k) Remove the two channels bolted to the aft end of the fuselage.

(l) Remove the glider tow and glider tow brackets.

(m) Pull the stabilizer aft (figure 121) until it is clear of the fuselage. Four men are required.

(2) VERTICAL STABILIZER.

(a) Remove the rudder, as described in paragraph 12. *b.* (3) *(b),* this section.

(b) Disconnect the two antenna wires from the lugs on the leading edge of the stabilizer tip by removing the bolts.

(c) Remove the fairing strips and collar (figure 124) from the bottom end of the de-icer shoe.

(d) Remove the access door (figure 124) in the fairing (false fin) forward of the stabilizer and disconnect the de-icer shoe line.

(e) Remove the four or five bolts which attach the rear spar of the stabilizer to the fuselage. To gain access to the bolt heads, it will be necessary to loosen the lower end of the cloth weather cover (figure 121) screwed to the aft side of the spar.

(f) Remove the machine screws which attach the stabilizer to the fuselage and the fairing. The

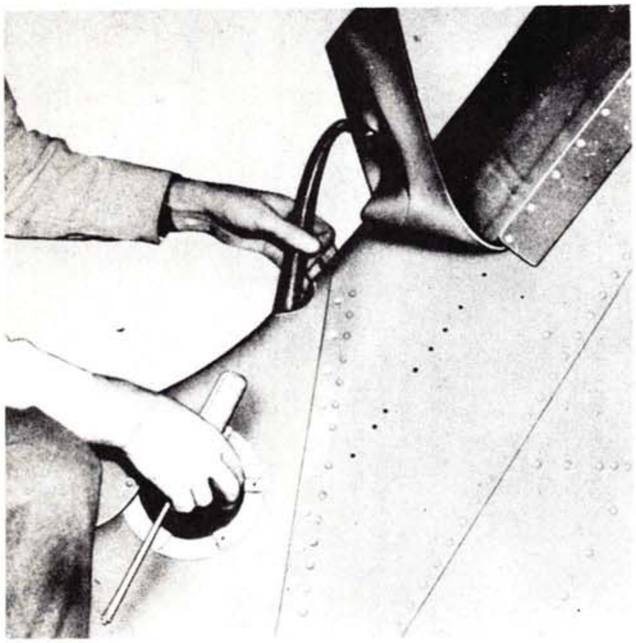


Figure 124—Detachment of De-Icer Shoe from Vertical Stabilizer

stabilizer attachment screws vary in length and it will be well to note where the different sizes are located.

(g) Tilt the stabilizer aft (figure 122) and lift it from the fuselage.

c. DISASSEMBLY.

(1) HORIZONTAL STABILIZER.

(a) To separate the interchangeable halves of the horizontal stabilizer, remove the attaching bolts.

(b) To remove the tip from the horizontal stabilizer, proceed as follows:

(c) Remove the de-icer shoe fairing strip and peel back the shoe, being careful not to tear it.

(d) Remove the machine screws which attach the tip to the stabilizer.

(2) VERTICAL STABILIZER.

(a) To remove the tip from the vertical stabilizer, proceed as follows:

(b) Remove the de-icer shoe fairing strip and peel back the shoe, being careful not to tear it.

(c) Remove the machine screws which attach the tip to the stabilizer.

d. MAINTENANCE REPAIR OR REPLACEMENT.

(1) For instructions on the repair of the horizontal or vertical stabilizer structure, refer to T.O. No. 01-40NC-3.

(2) Replace worn or broken bushings.

e. ASSEMBLY.—When assembling the two halves of the horizontal stabilizer, the bolts which attach the upper and lower sides together should be torqued to 40 ± 5 inch-pounds.

f. INSTALLATION.

(1) HORIZONTAL STABILIZER.—Reverse the removal procedure.

(2) VERTICAL STABILIZER.—Reverse the removal procedure, mounting the forward end first as shown in figure 122, and then pressing the aft end into place. Strips of metal used as "shoehorns" will be helpful when fitting the stabilizer skin over the fuselage skin. In factory installation, a special jig (figure 122) is used to obtain the "shoehorn" effect. It also will be helpful to attach one screw in the forward end of the splice to serve as a fulcrum and guide when the aft part of the stabilizer is being lowered into place. The attachment screws should be set in litharge and glycerin to insure a firm grip on the nut plates.

3. FUSELAGE.

a. DESCRIPTION.

(1) The fuselage is of semimonocoque construction consisting of upright frames made of formed 24ST alclad sheet and lengthwise stringers of 24ST extruded bulb angles, with some special longitudinal channels of 24ST sheet. The fuselage covering is 24ST alclad sheet.

(a) PILOT'S COMPARTMENT.—The pilot's compartment (figure 125) is located forward of station 86. The compartment may be entered through a door on the left side of the fuselage forward of the wing, or from within the main cargo compartment through a door in the bulkhead aft of the radio compartment. The flooring is of corrugated 24SRT alclad sheet. An emergency exit is located overhead, midway between the pilot's and copilot's seats, and is fitted with two orange-yellow release handles at its forward end.

(b) RADIO COMPARTMENT. — The radio compartment is located between the main cabin and the pilot's compartment on the right side of the companionway. There is a small baggage space in front of the radio compartment and a large baggage space directly across the companionway. On some airplanes the large baggage space is equipped to serve as a navigator's compartment. (See section V, paragraph 3.)

(c) MAIN CABIN OR CARGO COMPARTMENT.— The main cabin extends from the bulkhead aft of the radio compartment to the bulkhead forward of the lavatory. (See figure 126.) The cabin may be used for carrying cargo or troops, and provisions are made for the installation of 18 litters. There are seven windows on the right side of the compartment and six windows on the left side. The windows are equipped with gun ports, and the fifth window aft on each side is constructed to provide an escape hatch. The frames on these two windows are painted orange-yellow and the release handles, located under the windows, are marked "AUXILIARY EXIT." The Army-type bucket seats installed along both sides of the compartment may be folded into a stowed position, so that removal of the

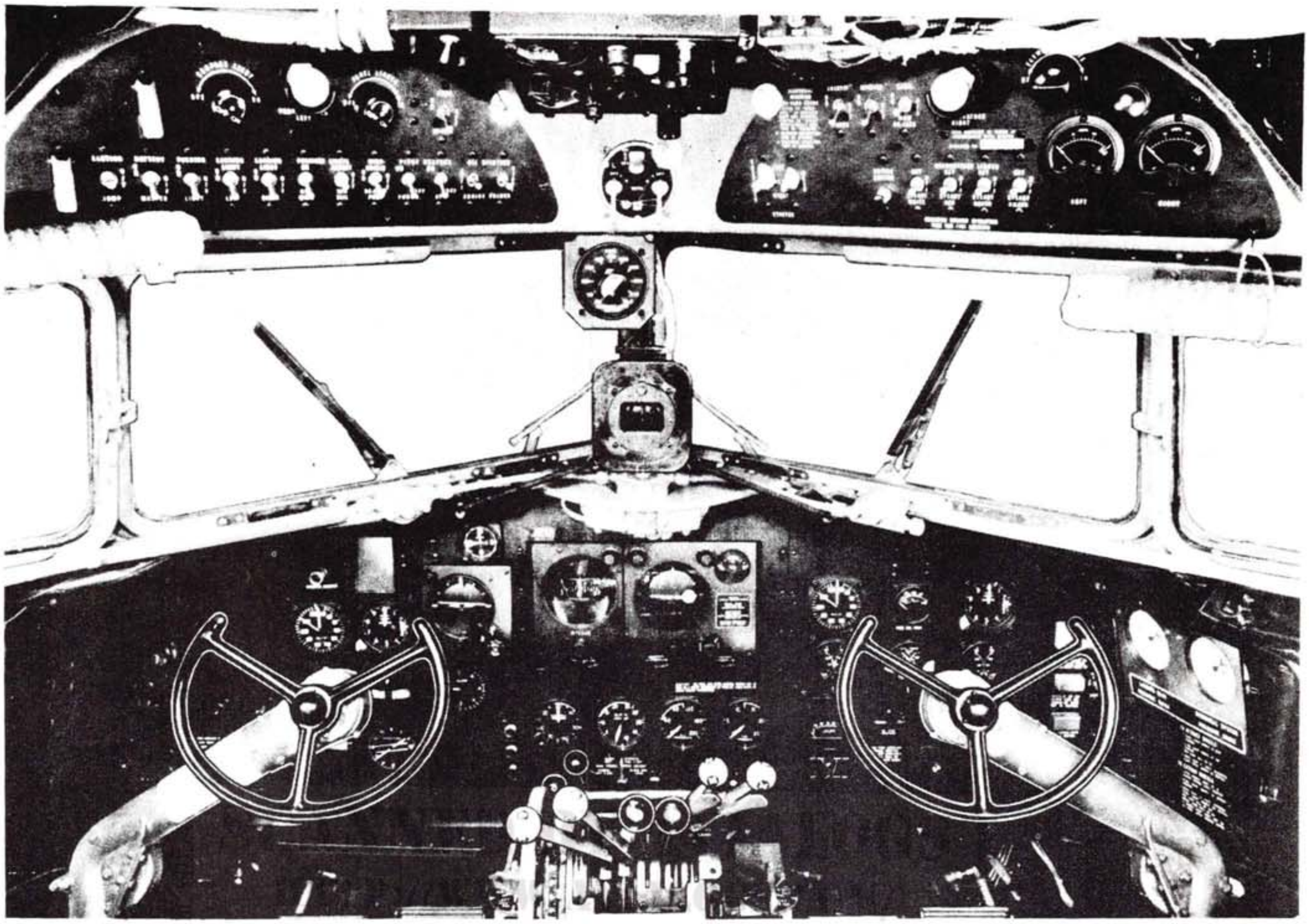


Figure 125—Pilots' Compartment

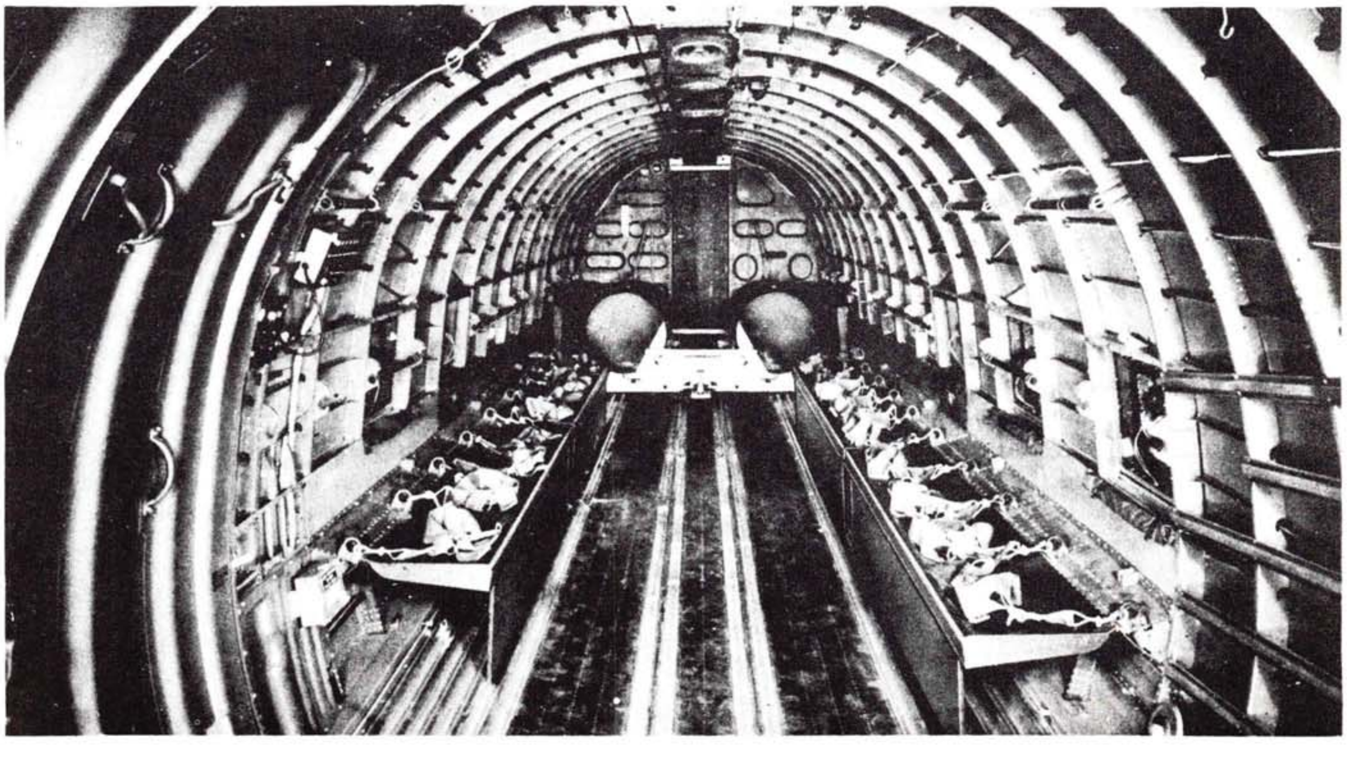


Figure 126—Main Cargo Compartment

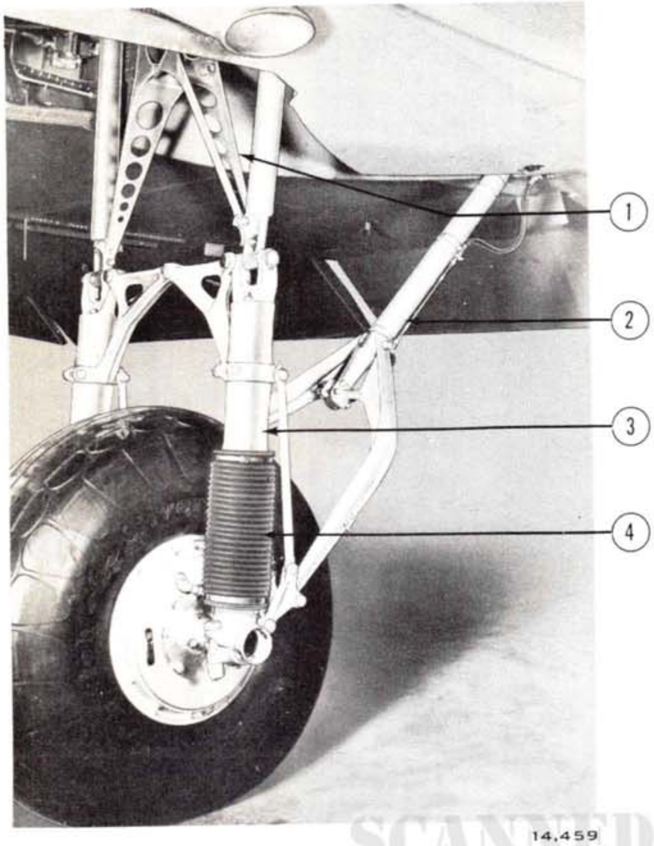


Figure 127—Main Landing-Gear Extended

1. Landing-Gear Upper Truss
2. Rear Brace Strut
3. Shock Absorber Strut
4. Dust Excluder (On Some Airplanes)

seats is not necessary when carrying cargo or litters. The floor of the compartment is of corrugated 24SRT alclad and is parallel to the line of flight from the forward bulkhead aft to the main cargo loading door from where it rises at an angle of 7½ degrees to the aft bulkhead. This rise in the floor provides a horizontal loading platform when the airplane is at rest. Provisions are also made for installing skidproof flooring in place of the regular flooring. The main loading door is located on the left side of the fuselage and has a removable panel at its forward end to facilitate quick exit of passengers while in flight.

(d) LAVATORY COMPARTMENT. – The lavatory compartment is located aft of the main cargo compartment. It includes a chemical disposal type toilet and a wash basin. Entrance to the lavatory is through a door in the cargo compartment rear bulkhead.

(e) TAIL COMPARTMENT.—The tail compartment is located aft of the lavatory. On some airplanes this compartment is removable. Entrance to the compartment is through a door in the rear bulkhead of the lavatory.

(f) TAIL CONE.—Attached to the aft end of the fuselage is a removable tail cone.

b. REMOVAL AND DISASSEMBLY.

(1) TO REMOVE THE TAIL COMPARTMENT.

(a) Support the fore and aft end of the tail compartment.

(b) Disconnect all control cables, wiring and lines in the tail compartment aft of the rear wall of the lavatory.

(c) Remove all bolts and nuts from the first frame aft of the lavatory rear bulkhead.

(d) Remove the tail compartment.

(2) TO REMOVE THE TAIL CONE.

(a) Remove the screws attaching the rear end of the stabilizer fairing to the tail cone.

(b) Remove the screws attaching the tail cone to the fuselage.

(c) Remove the tail cone by pulling it aft.

c. MAINTENANCE REPAIR.

(1) For diagrams and data pertaining to repair and replacement of fuselage plating, stringer and transverse frames, refer to T. O. No. 01-40NC-3, structural repair handbook for these airplanes.

(2) MAINTENANCE OF RADOME.—Handle radome carefully. Avoid subjecting the radome to hammering or clamping actions or to pressures concentrated on limited areas. If the radome is not mounted on the aircraft, it will be placed so that it rests on the reinforced mounting rim and not on the curved window area. Replace a cracked or punctured radome. Synthetic rubber radomes may be repaired if proper replacement radomes are not available. The procedure is as follows:

(a) Dissolve a small portion of a discarded rubber radome in acetone, gasoline, or other suitable solvent to obtain a cement of glue-like viscosity.

(b) Remove all paint surrounding the area to be patched.

(c) Cut out a circular piece containing the damaged area. (See Figure 127A.) If the piece removed is more than four inches in diameter, replacement will be required. No radome will contain more than two patches.

(d) From a discarded radome, cut out a circular piece to fit the opening made by removal of the damaged portion.

(e) Fabricate a wooden support (Figure 127A) and block it in position to support the patch when inserted. Make certain that edges of patch will contact edges of hole around entire circumference.

(f) Apply acetone rubber mixture to edges of patch. Insert patch and weight it down with shot bag or by other suitable means. Allow several hours for patch to set.

(g) Apply two coats of rubber-acetone mixture over the patched area, both inside and outside, and allow it to dry for at least 12 hours.

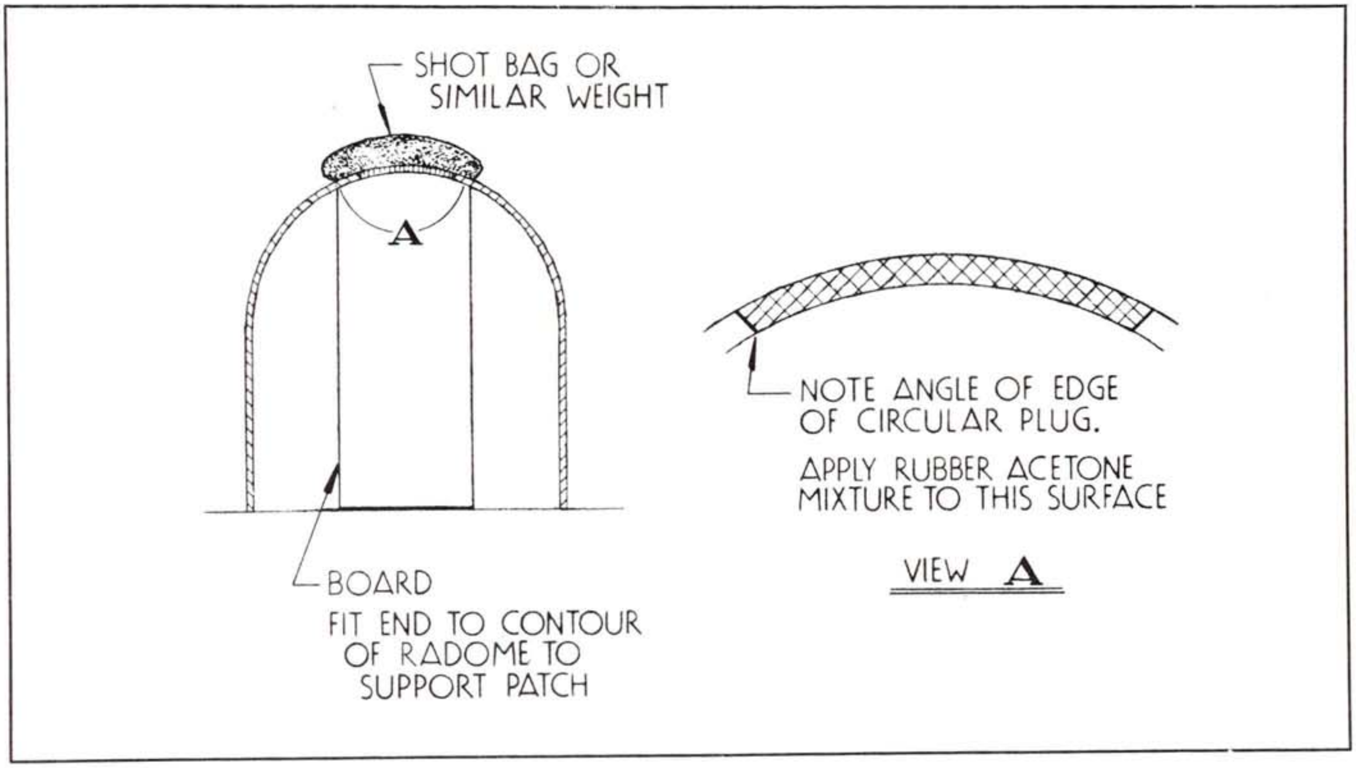

SHOT BAG OR SIMILAR WEIGHT
A
BOARD
FIT END TO CONTOUR OF RADOME TO SUPPORT PATCH
NOTE ANGLE OF EDGE OF CIRCULAR PLUG.
APPLY RUBBER ACETONE MIXTURE TO THIS SURFACE
VIEW A

Figure 127A—Radome Patch

(h) Test the patch by subjecting it to a load (from inside radome) of approximately four pounds per square inch.

(i) Paint the patch and surrounding area, using two coats of clear cellulose nitrate dope, Specification No. AN-TT-D-514, and one coat of shade 603 cellulose nitrate pigmented dope, Specification No. AN-D-8.

d. ASSEMBLY.—Installation of the tail compartment and the tail cone is accomplished by reversing the removal procedure.

4. LANDING GEAR.

a. GENERAL.—The landing gear consists of the main landing gear and a tail wheel gear. The hydraulically actuated main landing gear consists of two independent units, one mounted in each nacelle and so designed that the gears retract into the nacelle wheel wells. The tail wheel is not retractable but is full swiveling.

b. MAIN LANDING GEAR. *(See figure 127.)*

(1) GEAR AND OPERATING MECHANISM. *(See figures 128 and 129.)*

(a) DESCRIPTION.—Each main landing-gear wheel is mounted on an axle which is solidly clamped between two air-oil shock absorber struts. The two shock struts are connected at their upper ends by rigid trusses. Attached to the bottom of each shock strut piston tube are two triangular links, the top corners of of which are bolted to rods which are bolted to the shock strut cross bracing. The aft corners of the triangular links are bolted to the yoke-type rear brace strut, which is hinged at the upper end to the wing structure. The upper end of the shock absorber and wheel assembly is hinged to the upper truss, which rotates about its upper fittings, which are attached to the wing front spar. The hydraulic actuating cylinder piston rod is bolted to the upper truss and the actuating cylinder is attached to the nacelle structure aft of the fire wall. When the actuating cylinder piston rod is retracted, the upper truss is pulled forward and upward into the nacelle. Since the shock absorber and wheel assembly

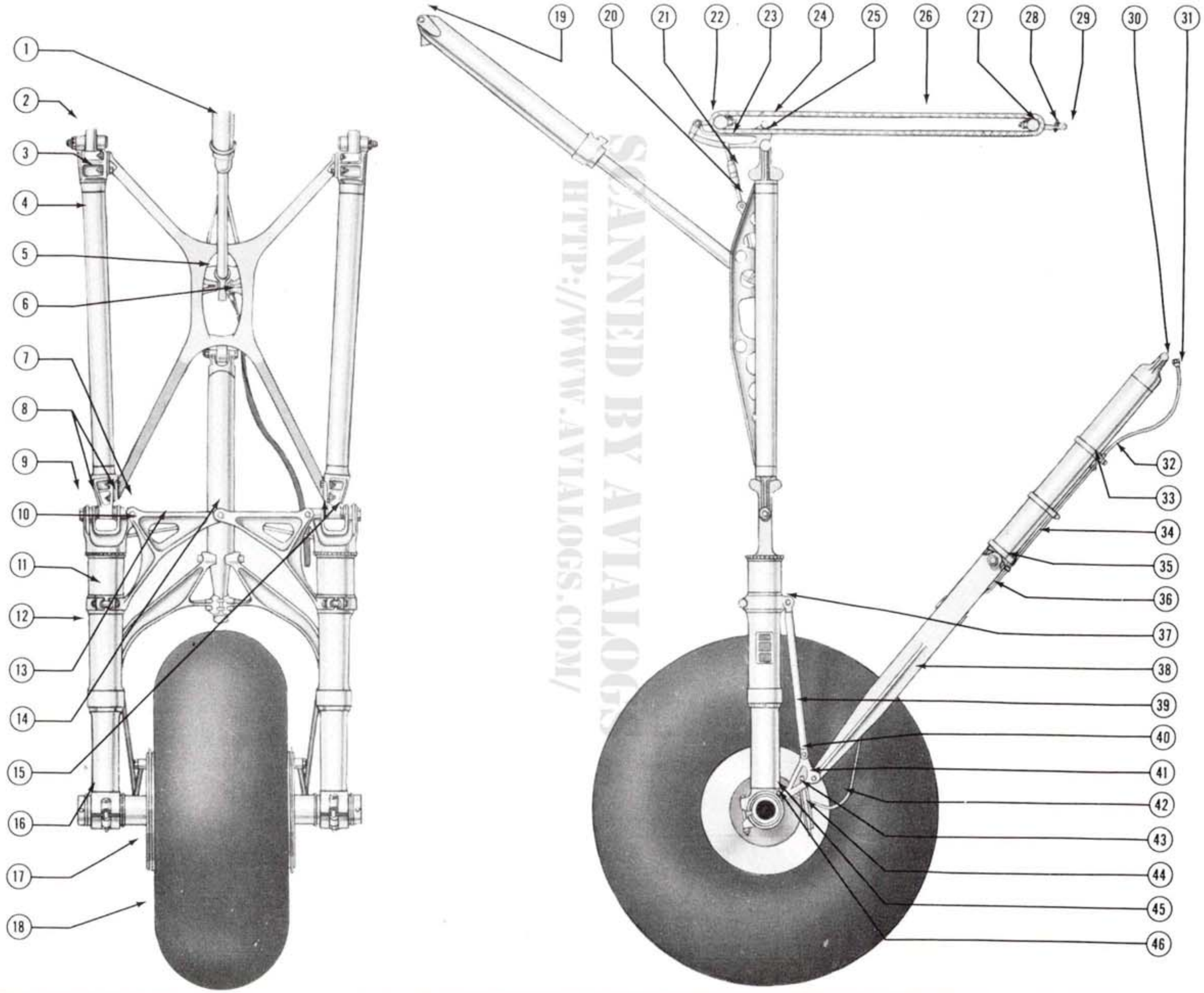

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

Figure 128—Main Landing-Gear Installation (With Bungee)

KEY TO FIGURE 128

(Douglas Drawing Nos. 5110568 and 5110589)

Item	*Part No.*	*Part Name*	*No. Req*
1	5140045	Actuating Cylinder and Line Assembly	2
2	1117078	Bolt	4
	AN320-12	Nut	4
	AN380-4-6	Cotter	4
	143908-030S118020	Washer (Use as Required to Obtain .001 to .020 End Clearance)	16
3	2139810	Rub Strip Assembly (Some Airplanes)	2
	AN515-8-12	Screw	2
	AF365-832	Nut	2
	AN960-8	Washer	2
4	5110569 or	Truss Assembly	2
	5141775	Truss Assembly (Optional)	2
5	111904-9-519B	Bolt	2
	AN320-9	Nut	2
	AN380-4-4	Cotter	2
	143908-018S028-032	Washer	4
	NAS59-31	Bolt (To Be Used With 5141775 Truss Assembly)	2
6	2114244	Safety Pin Assembly	2
7	111904-14-219	Bolt	2
	*143908-028S110-063	Washer	2
	*143908-028S110-034	Washer	2
	*Use as necessary for correct bolt take-up		
8	**143908-028S112-037	Washer	4
	**143908-028S112-050	Washer	2
	**143908-028S112-031	Washer	4
	**(Use as required to obtain .001 to .012 end clearance)		
9	1116955	Bolt	4
	1116954	Plate	4
	AN501A10-4	Screw	4
	AF995-C32-3	Lock Wire	4
10	5116414	Truss Assembly	2
11	AN10-33	Bolt	4
	AN310-10	Nut	4
	AN380-4-4	Cotter	4
12	65900	Bendix Shock Strut Assembly	2
13	2114145-1	Line	1
14	143908-020S100-032	Washer	1
	126480-5L	Clip	1
	1116412	Plate	1
	111904-10-206	Bolt	1
	AN320-10	Nut	1
	AN380-4-4	Cotter	1
	AF530-8-8	Screw	1
	1805-M-1	Tinnerman Nut	1
15	**143908-028S112-037	Washer	4
	**143908-028S112-050	Washer	2
	**143908-028S112-031	Washer	4
	**(Use as necessary to obtain .001 to .012 end clearance)		
16	53926	Bendix Bolt	(Ref)
	53927	Bendix Nut	(Ref)
	112-S-72	Bendix Cotter	(Ref)
17	5116415 and -1	Wheel Assemblies (See figure 150)	1 each
18		45 x 17:00 x 16 Tire and Tube	2 each
19	111904-9-323B	Bolt	2
	143908-018S028-063	Washer	2
	AN320-9	Nut	2
	AN380-4-4	Cotter	2

KEY TO FIGURE 128 (Continued)

Ref	*Part No.*	*Part Name*	*No. Req*
20	2139388	Link Assembly (Part of 5110569 Upper Truss Assembly)	2
	1114242	Spacer	4
	AN6-13	Bolt	4
	AN960-616	Washer	4
	AN310-6	Nut	4
	AN380-3-4	Cotter	4
21	AN155-80L	Turnbuckle	2
	AN165-80LL	Eye—LH	2
22	1116952	Eyebolt	2
	1116961	Nut	2
	AN960-616	Washer	2
	AN315-6R	Nut	2
23	1142476	Rod	2
	AN396-29	Pin	2
	AN396-55	Pin	2
	AN380-3-3	Cotter	4
	124682-6S10-031	Washer (Use as Necessary)	
24	111904-7-124B	Bolt	2
	1116953	Guard	2
	AN320-7	Nut	2
	AN380-3-3	Cotter	2
25	4116969	Toggle	2
	111904-6-119	Bolt	2
	AN320-6	Nut	2
	AN380-3-3	Cotter	2
	2116964	Brace	4
	AN3-42	Bolt	2
	AN3-15	Bolt	4
	AN310-3	Nut	6
	AN380-2-2	Cotter	6
26	2116965	Shock Cord	12
	4116968	Bungee Cover	2
	124682-1F7-063	Washer	38
	AN515-6-6	Screw	22
	AF365D632	Nut	22
	AF530-4-6	Screw	16
27	2116963	Yoke	4
28	1116961	Nut	2
	1116956	Bolt	2
	AN960-616	Washer	2
	AN315-6R	Nut	2
29	1116957	Shackle	2
	131736-7C-101	Bushing	2
	AN7-21	Bolt	2
	111904-5-102	Bolt	2
	AN310-7	Nut	2
	AN320-5	Nut	2
	AN380-3-3	Cotter	4
30	1113280	Bolt	2
	143908-020S100-063	Washer	4
	AN320-10	Nut	2
	AN380-4-4	Cotter	2
31	1203211	Adaptor (On some Airplanes)	(Ref)
32	2116966 or	Hose	(Ref)
	43D2474-6-240	Hose Assembly	(Ref)
33	1116959	Clamp Assembly	2
34	4116679-2	Line	(Ref)

KEY TO FIGURE 128 (Continued)

Item	Part No.	Part Name	No. Req
35	2142464	Strap	2
36	4116679-3	Line	(Ref)
37	1116411	Bushing	8
	AN10-45	Bolt	4
	143908-020S106-094	Washer	8
	AN310-10	Nut	4
	AN380-4-6	Cotter	4
38	5112599	Rear Brace Strut Assembly	2
39	2116697	Arm Assembly	8
40	111904-8-109B	Bolt	8
	AN320-8	Nut	8
	AN380-3-3	Cotter	8
41	1116409	Bolt	4
	143908-024S100-094	Washer	4
	AN320-10	Nut	4
	AN380-4-4	Cotter	4
42	1116960 or 1202670	Hose Assembly	(Ref)
43	4116413	Link—LH	4
	4116413-1	Link—RH	4
44	1116593	Guide—One Each Used on Each Side of Wheel	4
	1116594	Guide—One Each Used on Each Side of Wheel	4
	AN430AD4-6	Rivet	16
45	AF286-3	Lubricator	8
46	124682-12S18-063	Washer	4
	1116410	Bolt	4
	AN320-12	Nut	4
	AN380-4-5	Cotter	4

KEY TO FIGURE 129

(Douglas Dwg. No. 5203619)

Item	Part No.	Part Name	No. Req
1		Landing-Gear Actuating Cylinder	(Ref)
2	22087	Compensator Cylinder	2
	AN924-6D	Lock Nut	2
	AN902-6	Gasket	2
	AN396-29	Pin	2
	AN380-3-3	Cotter	2
3	2205622	Hose Assembly	2
	AN921-6D	Elbow	2
4	AN6-23	Bolt	2
	AN310-6	Nut	2
	AN380-3-4	Cotter	2
5	4142871	Bracket	2
6	AN6-23	Bolt	2
	AN310-6	Nut	2
	AN380-3-3	Cotter	2
7	1142744	Bolt	2
	AN316-10R	Nut	2
8	4204951	Cover Assembly	2
	124682-3F7-063	Washer	28
	AN530-10-8	Screw	28
	1779-10Z	Tinnerman Nut	8
9	4142751	Brace (Install with Square End up)	2
	4142751-1	Brace	2
	AN3-24	Bolt	2
	AN310-3	Nut	2
	AN380-2-2	Cotter	2
	AN3-6	Bolt	4

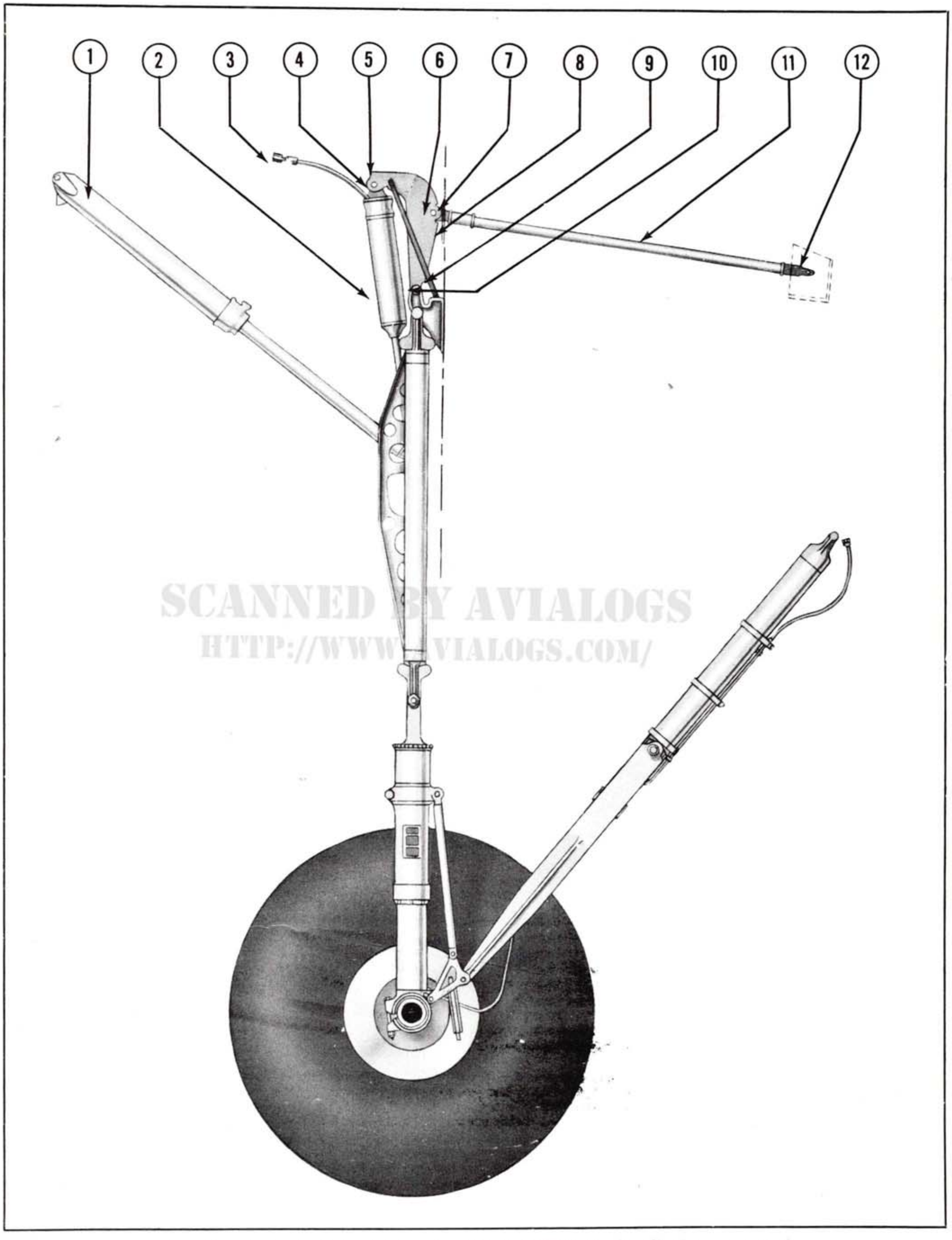

1
2
3
4
5
6
7
8
9
10
11
12

Figure 129—Main Landing-Gear Installation (With Hydraulic Compensator)

KEY TO FIGURE 129 (Continued)

Item	*Part No.*	*Part Name*	*No. Req*
	AN310-3	Nut	4
	AN380-2-2	Cotter	4
10	AN7-23	Bolt	2
	AN310-7	Nut	2
	AN380-3-4	Cotter	2
11	2142750	Tie Rod Assembly	2
12	AN7-21	Bolt	2
	AN310-7	Nut	2
	AN380-3-3	Cotter	2

NOTE: For remainder of landing-gear installation parts refer to figure 128.

is hinged to the lower ends of the upper truss, the wheel also is pulled up into the nacelle. (See figure 389.) When the gear is fully retracted, the projecting ends of the axles are held against rubber bumpers built into the sides of the nacelles and only a small portion of the tire projects below the lower contour of the nacelle. On some airplanes an elastic shock cord bungee was provided at the top of the landing installation to balance the weight of the landing gear. The bungee was replaced by a hydraulic compensator on later airplanes to assist the landing-gear actuating cylinder in retracting the gear. Retraction of the gear is accomplished by the following procedure:

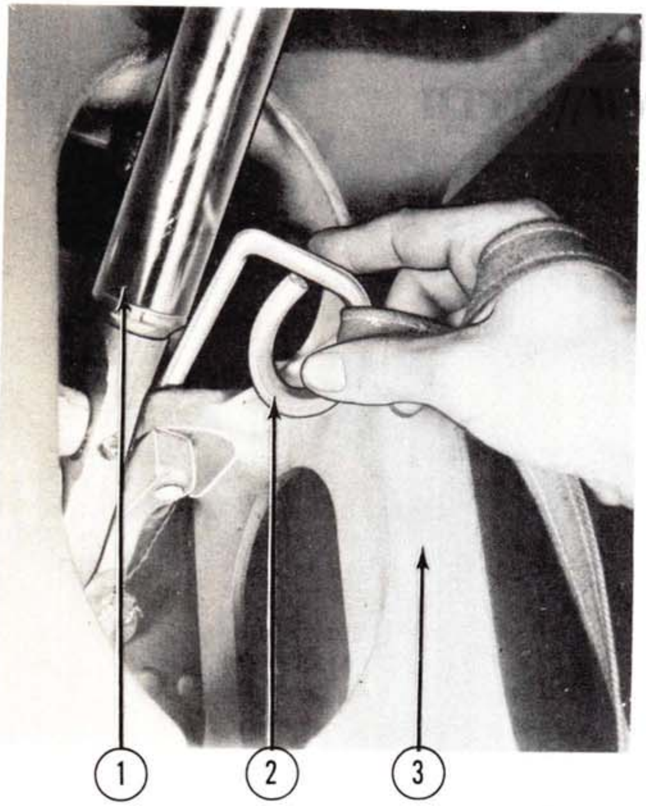


Figure 130—Installing Ground Safety Pin

1. Landing-Gear Actuating Cylinder Piston Rod
2. Ground Safety Pin
3. Landing-Gear Upper Truss

1. Place the mechanical safety latch control handle (figure 134) in the "LATCH RAISED" position. This will raise the safety latches, releasing the landing-gear actuating cylinder piston rod hooks.

2. Place the landing-gear control valve handle (figure 361) in the "UP" position. Hydraulic fluid under pressure then will be directed to the lower end of the actuating cylinder, retracting the piston rod, which in turn pulls the gear into the nacelles. The green landing-gear lamp will go out and the landing-gear red warning lamp will light.

3. When the landing gear has been fully retracted, place the landing-gear control valve handle in the "NEUTRAL" position. There are no mechanical locks to hold the gear in the "UP" position. Only fluid pressure in the actuating cylinder holds the gear in the retracted position. Therefore, the landing-gear control valve is placed in the "NEUTRAL" position after retraction of the landing gear to retain fluid pressure in the "UP" line.

Note

> The mechanical safety latch control automatically will return to the "SPRING LOCK" position.

4. The landing gear is extended by the following procedure:

a. Make certain that the mechanical safety latch control handle is in the "SPRING LATCH" position. If the safety latch is moved into the "LATCH RAISED" position by mistake, it may be returned to the "SPRING LOCK" position by moving the safety latch dog knob forward or by raising the landing-gear control valve handle toward the "UP" position.

b. Move the landing-gear control valve handle into the "DOWN" position. Check the landing-gear hydraulic pressure gage for a minimum pressure of 500 psi. Hydraulic fluid under pressure is directed to the upper end of the landing-gear actuating cylinder and the piston rod extends, forcing the landing gear to extend

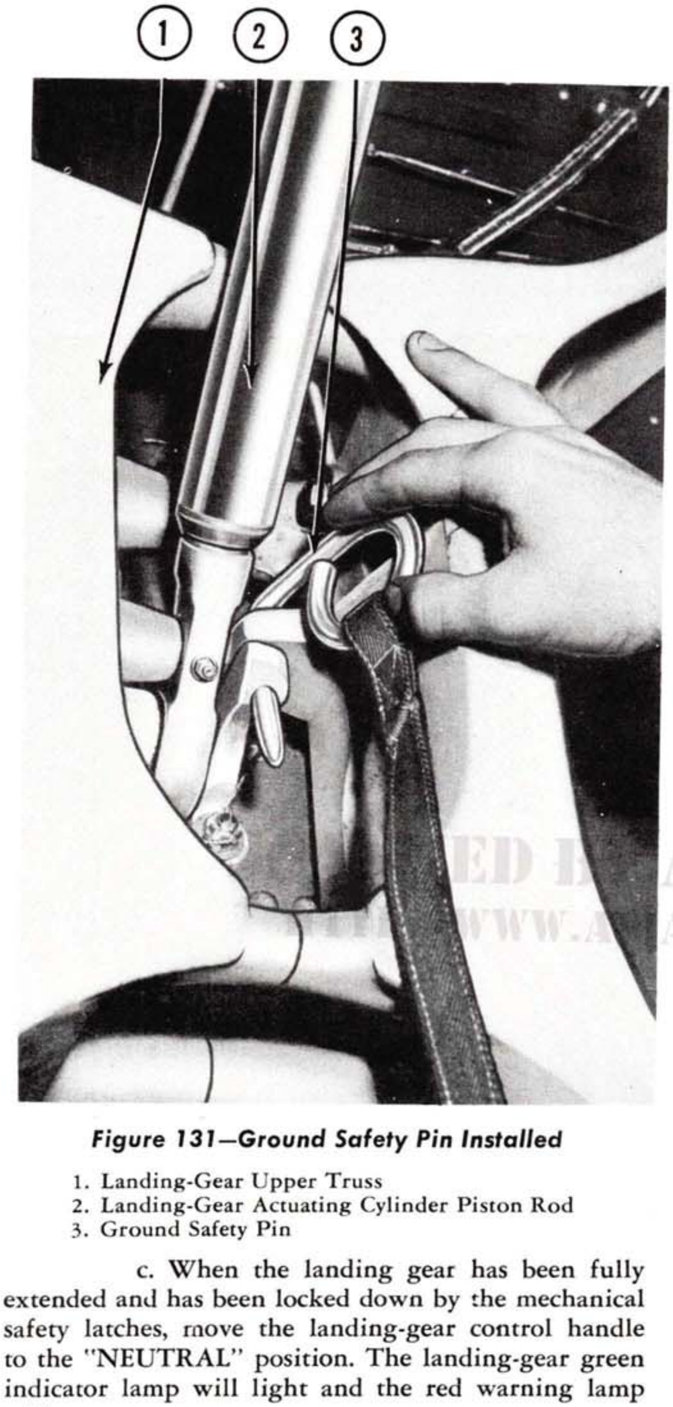


Figure 131—Ground Safety Pin Installed

1. Landing-Gear Upper Truss
2. Landing-Gear Actuating Cylinder Piston Rod
3. Ground Safety Pin

c. When the landing gear has been fully extended and has been locked down by the mechanical safety latches, move the landing-gear control handle to the "NEUTRAL" position. The landing-gear green indicator lamp will light and the red warning lamp will go out.

d. Clip the safety latch control handle to the floor in the "POSITIVE LOCK" position. The locking clip should be placed over the safety latch control handle ONLY when the landing gear is fully extended and locked down.

Note

If the airplane is left standing on the ground for some time, move the landing-gear control valve handle to the "DOWN" position to prevent damage to the landing-gear hydraulic lines by thermal expansion of the hydraulic fluid. Refer to section IV, paragraph 13. *c.*(1).

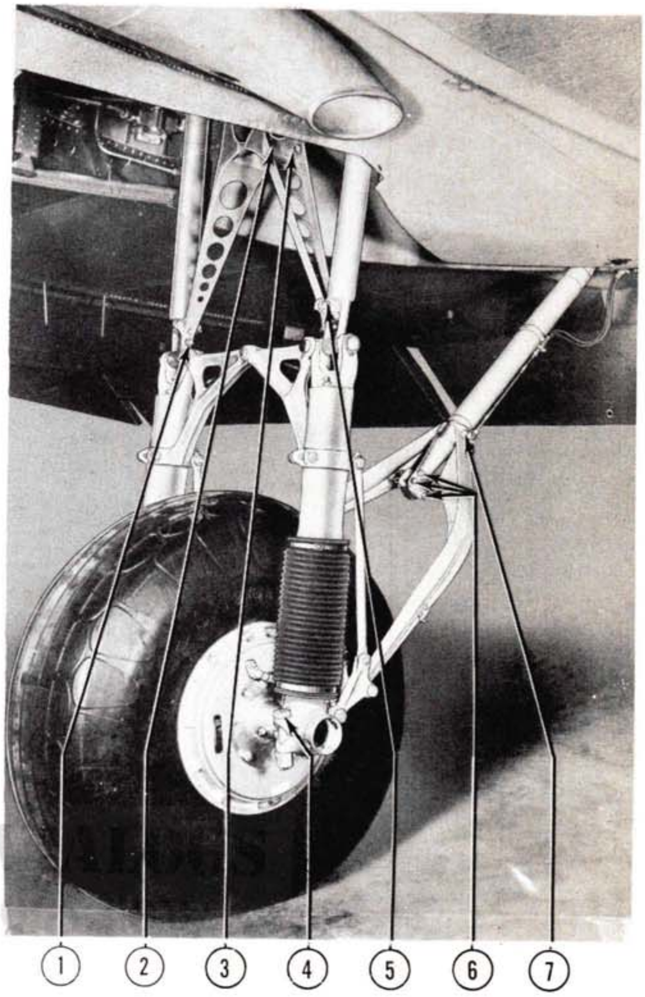


Figure 132—Main Landing-Gear Bolt Torque Values

1. AF365-.624 Nut (4 places). (Apply 17 foot-pounds torque to nut.)
2. 12B-080 Internal Wrenching Nut (2 places on some airplanes.) (Apply 83 foot-pounds torque to nut.)
3. 12B-108 Internal Wrenching Nut (2 places on some airplanes.) (Apply 177 foot-pounds torque to nut.)
4. 53926 Bendix Axle Clamp Bolt (2 places). (Apply 2160 ±240 inch-pounds to nut)
5. AF365-820 Nut (8 places). (Apply 39 foot-pounds torque to nut)
6. 12B-064 Internal Wrenching Nut (4 places). (Apply 30 foot-pounds torque to nut)
7. 12B-080 Internal Wrenching Nut. (Apply 70 foot-pounds torque to nut)

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Support the airplane on wing jacks, as instructed in section III, paragraph 2. *b.* (1) *(a)*.

b. Remove the bungee, if installed, as instructed in this paragraph, *b.* (5) *(a) 2.*, or remove the hydraulic compensator as instructed in this section, paragraph 13. *c.* (4) *(b) 1.*

c. Disconnect the landing-gear actuating cylinder piston rod from the upper truss by removing the attaching bolt and raising the safety latch.

d. Disconnect and cap the brake hydraulic line at the upper end of the rear brace strut.

e. If a suitable stand to support the gear is available, each main landing gear may be removed as a unit. Remove the bolts that attach the shock struts to the upper truss and the bolt that attaches the upper end of the rear brace strut to the wing structure and remove the wheel, shock struts, and rear brace strut. The upper truss then may be removed by removing the attaching bolts.

f. If a stand to support the gear is not available, it may be necessary to remove the landing gear as follows:

(1) Remove the wheel and axle assembly as instructed in this paragraph, *b.*(6)*(b)2.*

(2) Remove the rear brace strut by removing the attaching bolts. Remove the shock strut assemblies from the upper truss. Remove the upper truss.

2. DISASSEMBLY.—Refer to the individual units in this paragraph for disassembly instructions.

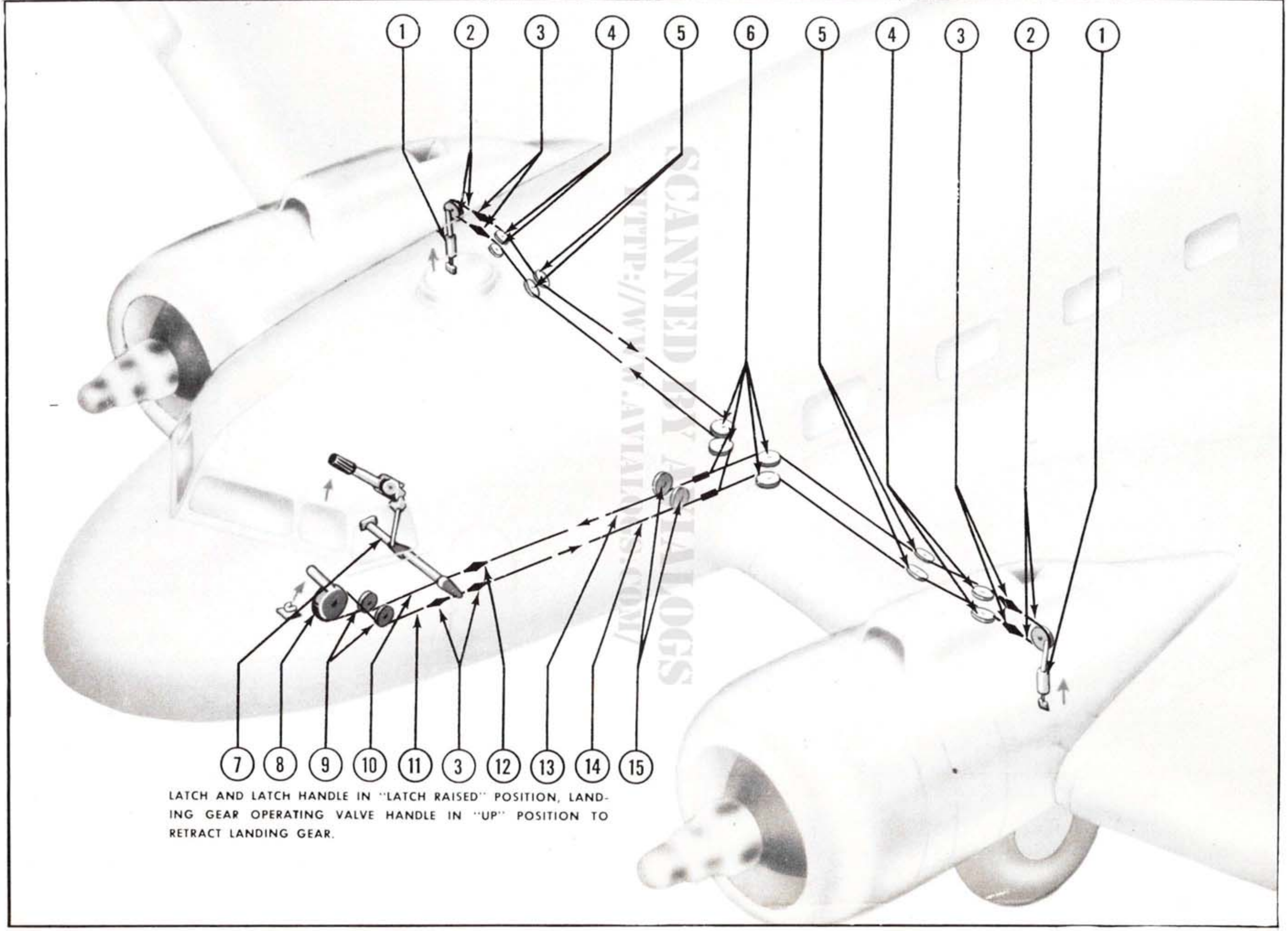
(c) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to the individual units in this paragraph for maintenance repair or replacement information. Refer to the lubrication chart (figure 84) for landing-gear lubrication instructions. Refer to bushing chart at end of this paragraph when it is necessary to replace bushings on the landing gear.

(d) ADJUSTMENTS.—To adjust the landing gear for proper travel and operation in conjunction with the mechanical safety latch refer to this paragraph, *b.*(3)*(d).*

KEY TO FIGURE 133
(Douglas Dwg. No. 5110570)

Item	*Part No.*	*Part Name*	*No. Req*
1		Mechanical Safety Latch Assembly (See figure 136)	(Ref)
2	1117033	Cable Assembly (Part of 2117376 Pulley Assembly)	(Ref)
3	AN155-85	Barrel	6
4	AN210-1A	Pulley	4
	AN3-30	Bolt	2
	AN310-3	Nut	2
	AN380-2-2	Cotter	2
5	AN210-2A	Pulley	4
	AN3-10	Bolt	2
	AN310-3	Nut	2
	AN380-2-2	Cotter	2
6	AN210-2A	Pulley	4
7		Torque Tube and Landing-Gear Control Valve Mechanism (See figure 141)	(Ref)
8		Mechanical Safety Latch Control Handle (See figure 140)	(Ref)
9	AN210-2A	Pulley	2
	1117043	Link	1
	138275-6-19	Spacer	1
	138275-6-57	Spacer	1
	AN3-16	Bolt	2
	AN310-3	Nut	2
	AN380-2-2	Cotter	2
	138275-6-38	Spacer	1
10	1117031-3	Cable Assembly	*(Ref)
11	1117031-1	Cable Assembly	*(Ref)
		*Included in 2117377 Handle **Assembly**	
12	1139505	Barrel	1
13	2117032-4	Cable Assembly (Latch Raising)	1
14	2117032-1	Cable Assembly (Positive Locking)	1
15	AN210-1A	Pulley	2
	AN23-16	Bolt	1
	AN320-3	Nut	1
	AN380-2-2	Cotter	2
	143358-023A	Pin	1

NOTE: For cable fabrication information refer to section IX.


1
2
3
4
5
6
5
4
3
2
1
7
8
9
10
11
3
12
13
14
15

LATCH AND LATCH HANDLE IN "LATCH RAISED" POSITION, LANDING GEAR OPERATING VALVE HANDLE IN "UP" POSITION TO RETRACT LANDING GEAR.

Figure 133—Mechanical Safety Latch System

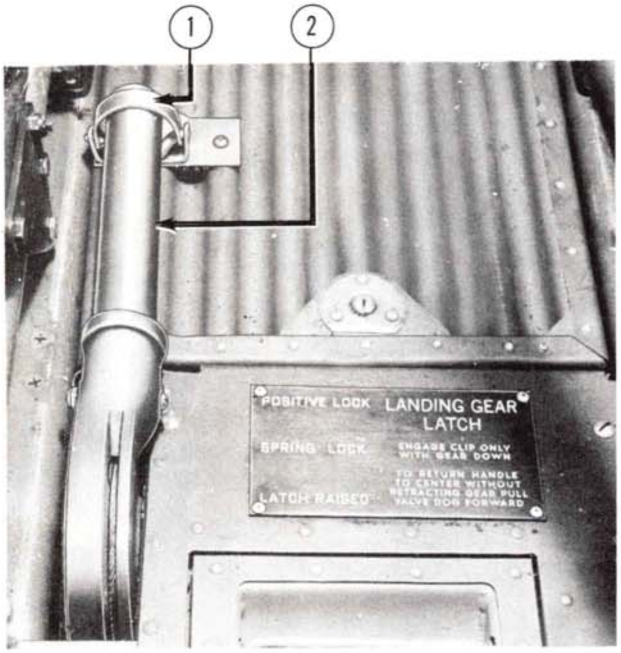


Figure 134—Mechanical Safety Latch Control Handle Installed

1. Positive Locking Clip
2. Safety Latch Control Handle

(e) INSTALLATION.—To install the landing gear reverse the removal procedure as given in this paragraph, *b.* (1) *(b).*

Note

> If the wheel and axle assembly is installed, tighten the axle clamp bolt to a torque of 2160 ± 240 inch-pounds. Refer to figure 132 for other main landing-gear bolt torque values. When a complete landing-gear assembly is installed, a careful check should be made for adequate clearance between the gear and the nacelle structure. Retract the gear slowly by operating the hydraulic hand pump. Carefully inspect the landing-gear mechanical safety latch.

(2) LANDING-GEAR HYDRAULIC SYSTEM. *(See figure 388.)*—The main landing gear is retracted and extended by two hydraulic actuating cylinders, one located in each nacelle. The operation of the actuating cylinders is controlled by a four-way hydraulic valve, located on the hydraulic control panel. For complete description and information about the landing-gear hydraulic system, refer to this section, paragraph 13. *c.*

(3) MECHANICAL SAFETY LATCH SYSTEM. *(See figure 133.)*

(a) DESCRIPTION. – A spring-loaded, mechanical safety latch (figure 135) is installed in each nacelle on the forward side of the wing front spar. The unit automatically latches, when the landing gear is fully extended, by engaging a slot (figure 136) in the lower end of the actuating cylinder piston rod. Latches for both gears are controlled simultaneously by cables connected to a single control handle (figures 134 and 140) located on the floor to the right of the pilot's seat. The control handle has three positions: "LATCH RAISED," which releases the landing gear for retraction; "SPRING LOCK," which receives and latches the landing-gear actuating cylinder hook (landing gear extended); and "POSITIVE LOCK," for safety locking the actuating cylinder piston rod hook when the gear is extended completely. The control handle is connected by linkage to a catch and dog (figure 141) on the landing-gear control valve. The catch and dog prevent the control valve from being moved into the "UP" position if the mechanical safety latch is in the "POSITIVE LOCK" or "SPRING LOCK" positions. For operating instructions refer to this paragraph, *b.* (1) *(a)* and figure 135.

(b) REMOVAL AND DISASSEMBLY.

1. Remove the bolts which attach the linkage to the catch and dog mechanism on the landing-gear control valve.

2. Disassemble the turnbuckles and remove the cable controls.

3. Remove latch or other parts, as necessary, by unscrewing attaching bolts.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. The landing-gear mechanical safety latch system requires no maintenance other than periodic inspection to determine general condition and security of all parts. Worn or damaged parts should be replaced with new parts.

2. Lubricate the mechanical latch assembly through the grease fitting as prescribed in figure 84 (sheet 4 of 5 sheets). Remove the dust cover and clean the latch mechanism; check for corrosion before lubricating the mechanism. Lubricate the latch mechanism with hydraulic fluid, Specification No. AN-VV-O-366, in cold weather.

(d) ADJUSTMENTS.

1. ADJUSTMENT OF LATCH GUIDE.

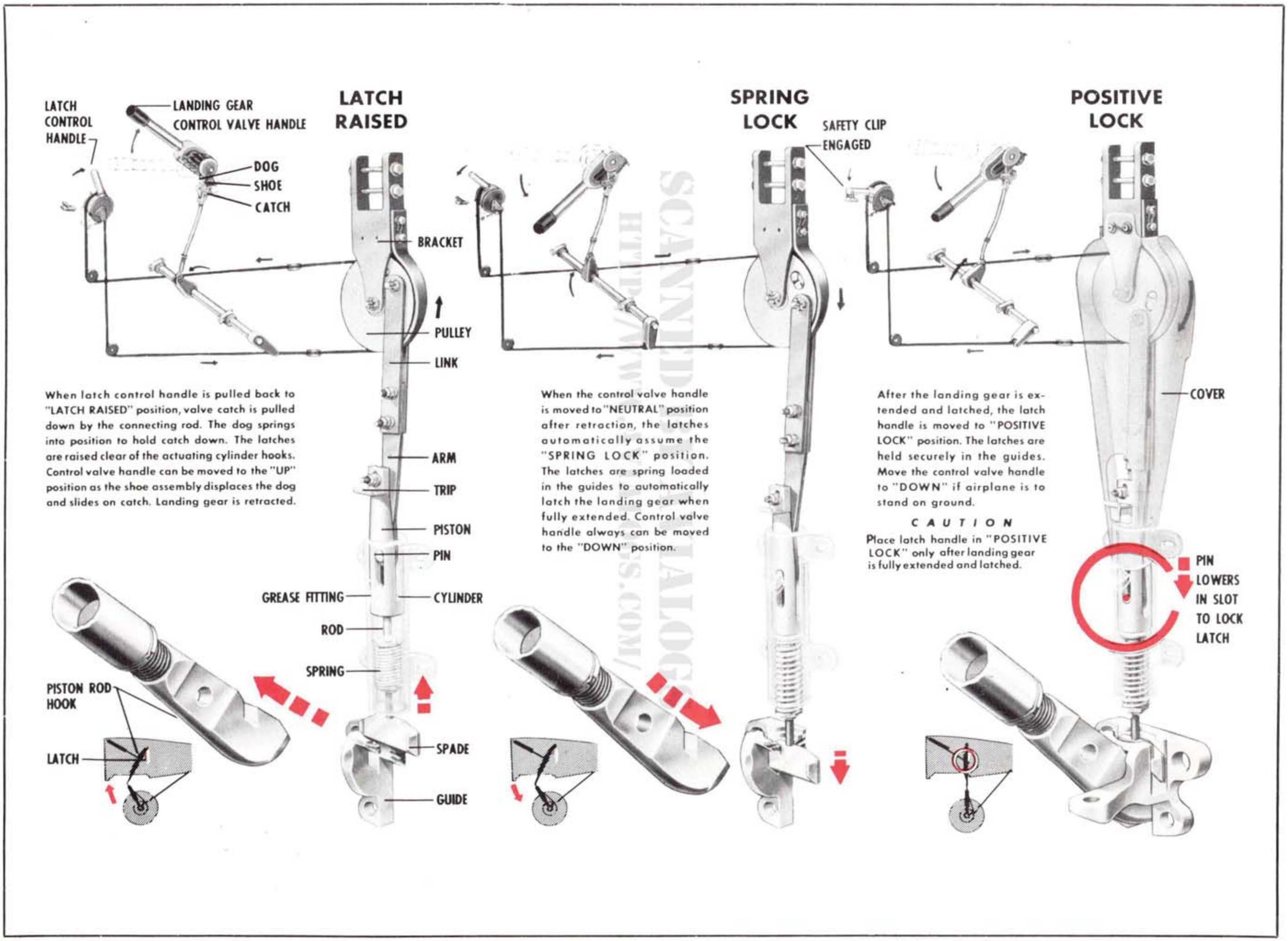
a. Position the hook on the landing-gear actuating piston rod so that it is centered in the latch guide.

b. The guide may be moved to the right or left simply by loosening the attaching nuts.

c. Any movement of the guide requires a similar movement in the latch mechanism. Oversize holes also permit movement of the latch by loosening the attaching nuts.

d. Further adjustment, if necessary, is made by shifting the position of the spacing washers, between the hook and the landing-gear upper truss. Follow closely all dimensions called for in figure 137.

e. The latch guide may be moved up or down to obtain the proper position in respect to the bottom face of the hook slot. Bottom face of the hook


LATCH RAISED
SPRING LOCK
POSITIVE LOCK
LATCH CONTROL HANDLE
LANDING GEAR CONTROL VALVE HANDLE
DOG
SHOE
CATCH
BRACKET
PULLEY
LINK
ARM
TRIP
PISTON
PIN
GREASE FITTING
CYLINDER
ROD
SPRING
SPADE
GUIDE
PISTON ROD HOOK
LATCH
SAFETY CLIP ENGAGED
COVER
PIN LOWERS IN SLOT TO LOCK LATCH

When latch control handle is pulled back to "LATCH RAISED" position, valve catch is pulled down by the connecting rod. The dog springs into position to hold catch down. The latches are raised clear of the actuating cylinder hooks. Control valve handle can be moved to the "UP" position as the shoe assembly displaces the dog and slides on catch. Landing gear is retracted.

When the control valve handle is moved to "NEUTRAL" position after retraction, the latches automatically assume the "SPRING LOCK" position. The latches are spring loaded in the guides to automatically latch the landing gear when fully extended. Control valve handle always can be moved to the "DOWN" position.

After the landing gear is extended and latched, the latch handle is moved to "POSITIVE LOCK" position. The latches are held securely in the guides. Move the control valve handle to "DOWN" if airplane is to stand on ground.

CAUTION

Place latch handle in "POSITIVE LOCK" only after landing gear is fully extended and latched.

Figure 135—Operation of Mechanical Safety Latch

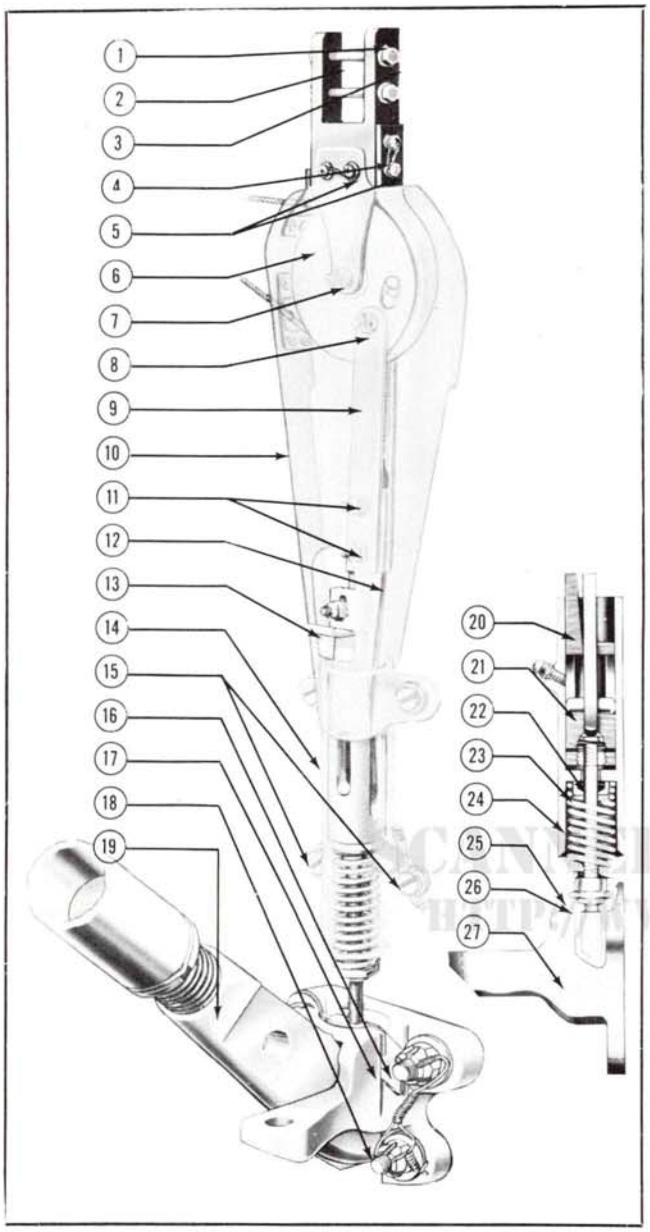


Figure 136—Mechanical Safety Latch Assembly

slot should be 1/64- to 1/32-inch below the face of the latch guide slots. (See figure 138.)

2. ADJUSTMENT OF ACTUATING CYLINDER.

a. Hold the actuating cylinder piston rod with a wooden clamp or a strap wrench. (See figures 142 and 143.) Loosen the lock nut (figure 138) and turn down sufficiently so that the piston rod may be turned to adjust the hook end.

b. Apply full "DOWN" pressure in the landing-gear hydraulic system and place safety latch handle in "LATCH RAISED" position.

c. Note relationship of aft face of hook slot with aft face of guide slots. Follow closely dimensions shown in figure 138.

d. Relieve the hydraulic system pressure by operating the wing flaps. Keep the landing-gear control valve in the "DOWN" position. Turn the actuating cylinder piston rod with service tool K21714 (figure 142) or a wooden clamp (figure 143) or strap wrench until the proper adjustment is obtained. One complete turn of the piston rod results in a lengthening or shortening of 1/16 inch. Apply full "DOWN" pressure in the landing-gear hydraulic system and repeat step c. above. The piston rod clamps may be fabricated according to figures 89 and 90.

e. Relieve the hydraulic system pressure by operating the wing flaps and recheck. With this condition, the aft face of the hook slot never must be forward of the aft faces of the guide slots.

f. Unscrew the piston rod ⅛ turn and screw the lock nut snugly. Tighten the piston rod ⅛ turn against the lock nut. This will insure that the piston rod hook is located in its exact position.

g. Recheck the adjustment.

h. Safety by punching lock washer lightly into slots in the lock nut and piston rod. Remove wooden clamp or strap wrench.

KEY TO FIGURE 136

(Douglas Dwg. No. 5110570)

Item	*Part No.*	*Part Name*	*No. Req*
1	2117066	Bracket	1
2	AN960-A10L	Washer (Shim as Necessary to Provide .015 Maximum Play)	2
	AN960-10L	Washer	2
	AN960-10	Washer	2
3	AN3-21A	Bolt	2
	AN960-10	Washer	2
	AN365-1032	Nut	2
4	1117054	Guard	1
5	AF500-A8-5	Screw	4
	AF995-C-40-5	Lock Wire	2

KEY TO FIGURE 136 (Continued)

Item	Part No.	Part Name	No. Req
6	2117376	Pulley Assembly	1
	Consists of		
	2117378	Pulley	1
	1117033	Cable Assembly (Refer to section IX for cable fabrication information)	2
	1117373	Button	2
7	AN3-10	Bolt	1
	AN310-3	Nut	1
	AN380-2-2	Cotter	1
8	AN3-7	Bolt	1
	1117046	Bushing	1
	124682-3D7-032	Washer	2
	AN310-3	Nut	1
	AN380-2-2	Cotter	1
9	1117050	Link	2
10	5117072 or	Cover—LH	1
	5117072-1	Cover—RH	1
11	AN3-7A	Bolt	2
	1117047	Shim	2
	AN960-10	Washer	2
	AC365-1032	Nut	2
12	1117049	Arm Assembly	1
	Consists of		
	1117049-1	Arm	1
	116500-5C-008	Bushing	1
13	1117053	Trip	1
	AN3-5A	Bolt	1
	AN960-10	Washer	1
	AN365-1032	Nut	1
14	2114600	Cylinder Assembly	1
	Consists of		
	2114600-2	Cylinder	1
	NAS-2-201	Lubrication Fitting	1
15	AF501A-10-5	Screw	4
	AN960-10L	Washer	4
	AF995-C40-8	Lock Wire	1
16	AN310-7	Nut	2
	143908-014S030-125	Washer	2
17	2114381	Latch	1
18	AN310-6	Nut	2
	143908-012S028-125	Washer	2
	AF995-C40-10	Lock Wire	2
19		Landing-Gear Actuating Cylinder Hook	(Ref)
20	2117065	Piston	1
21	1117051	Pin	1
22	1117052	Rod	1
23	1117048	Retainer	1
	126221-2-4-8	Felt Washer	2
24	1117056	Spring	1
25	1130820	Nut	1
26	AN316-4	Nut	1
27	5114203	Guide	1

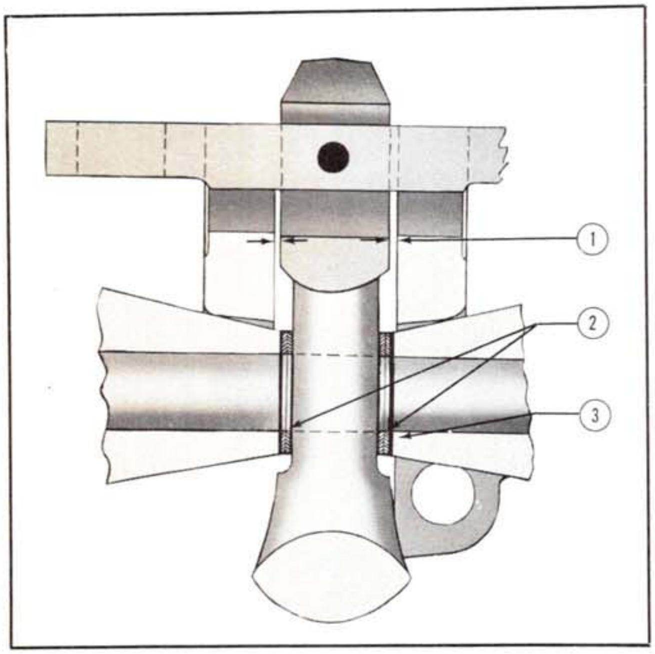


Figure 137—Adjustment of Actuating Cylinder Hook and Safety Latch Guide

1. Minimum Clearance Either Side—.035 Inch
2. Spacing Washers
3. Allowable Side Play—.010 Inch

i. Release safety latch into "SPRING LOCK" position.

3. ADJUSTMENT OF LATCH CONTROL SYSTEM.

a. Adjust all turnbuckles in nacelles and under floor so that threads are just buried.

b. Place latch control handle in "LATCH RAISED" position and note position of latches in nacelles.

c. Adjust nacelle cables until latches are in same position (dimensional adjustment is not necessary at this step).

d. Release latches to "SPRING LOCK" position. Cables should have a tension of 30 pounds in the nacelles.

e. Check latch handle for from ⅜- to ½-inch springback in the "POSITIVE LOCK" position. This can be increased by loosening the turnbuckles on the "LATCH RAISED" cable and tightening the rear turnbuckle on the "POSITIVE LOCK" cable located beneath the pilot's compartment floor. (Adjust only the rear turnbuckle on the "POSITIVE LOCK" cable.) Tension of the cables in the "SPRING LOCK" position at this station should be approximately 60 pounds.

f. Place control handle in the "SPRING LOCK" position. Adjust fore and aft turnbuckles on positive lock cable so that arm (figure 141) on torque tube is perpendicular to the floor of the compartment.

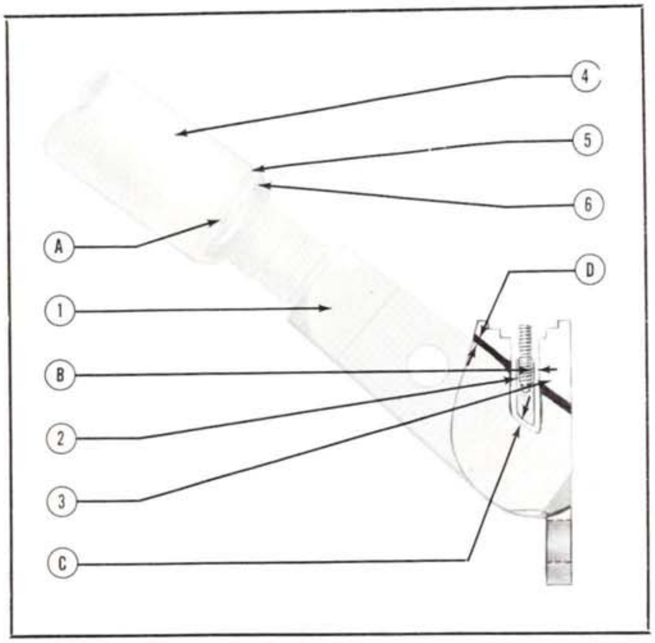


Figure 138—Adjustment of Actuating Cylinder Hook and Safety Latch Guide

A. Stake lock washer into lock nut and piston rod after adjustment has been made
B. 1/64- to 1/32-inch clearance with full DOWN pressure in landing-gear hydraulic system. Flush to 1/32 inch with no DOWN pressure.
C. 1/64- to 1/32-inch clearance
D. 3/32-inch minimum clearance with latch control handle in the "LATCH RAISED" position.

1. Hook
2. Latch
3. Guide
4. Piston Rod
5. Lock Washer
6. Lock Nut

Note

Since there is a slight amount of free play in the "SPRING LOCK" position the handle should be placed in the forward portion of the free play while making this adjustment.

g. With the landing-gear control valve in "NEUTRAL" position, adjust the connecting rod to give 1/16-inch clearance between dog and catch at valve when the latch control handle is held full back.

h. Release the latch handle. It should remain in the "LATCH RAISED" position. Check for 3/32-inch clearance of the latches above the strut hook. (This can be seen only with the aid of a small dental mirror and a flashlight.)

i. Pull forward on knob of latch dog at landing-gear control valve. Latches should release into "SPRING LOCK" position. The latch handle should be at an angle of approximately 30 degrees from the floor and the latches should be full down in the guides.

j. Place latch handle full down and clip in "POSITIVE LOCK" position. It should be impossible to force the latches up with a screw driver or similar tool.

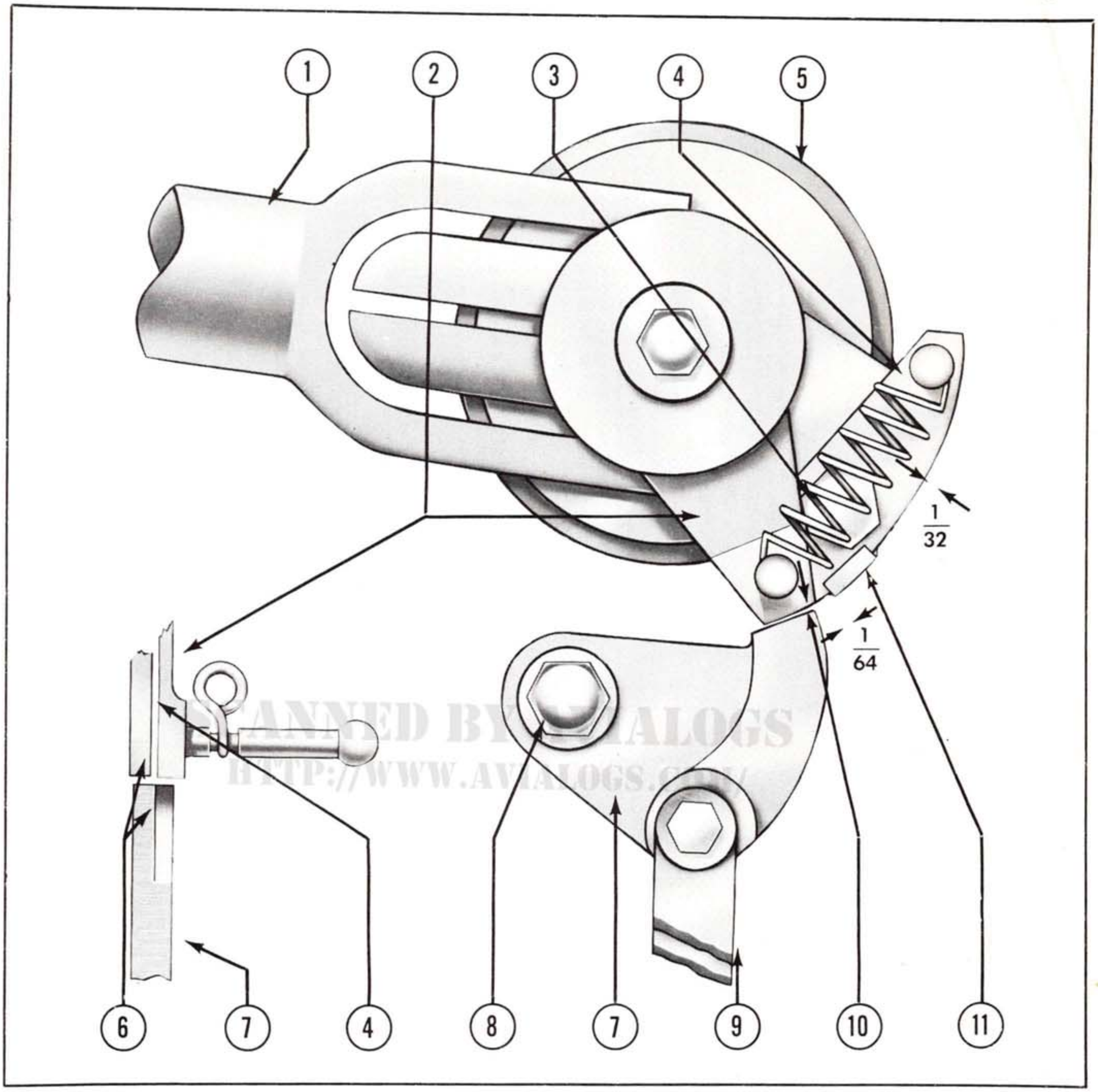


Figure 139—Adjustment of Control Valve Safety Latch Mechanism

1. Landing Gear Control Valve Handle in "NEUTRAL" Position With Latch Control Handle Full Back in "LATCH RAISED" Position
2. Dog
3. Flat Side of Bolt Head Must Engage Aft Side of Dog as Shown
4. Shoe
5. Landing Gear Control Valve
6. These Faces Must be Flush Within 1/32 Inch
7. Catch
8. Washers—Use as Necessary to Obtain Dimensions Given in Item 6 for Faces of Catch and Shoe
9. Rod—Adjust to Obtain Dimension Given in Item 10
10. 1/16 Inch—Measured When Latch Handle is Held Back in "LATCH RAISED" Position
11. Stop Must Engage Dog by 1/16-Inch Minimum With Control Valve Handle in "DOWN" Position and Latch Handle in "LATCH RAISED" Position

k. With the latch handle in the "LATCH RAISED" position, move landing-gear control valve into "DOWN" position. The stop should prevent the dog from passing and should engage it by 1/16-inch (figure 139). Move control valve back to "NEUTRAL."

l. Check the relation of the faces of the valve shoe and valve catch (figure 139). Shift washers at catch to obtain desired results.

(e) INSTALLATION.—The installation of any parts of the mechanical safety latch system is the reverse of removal.

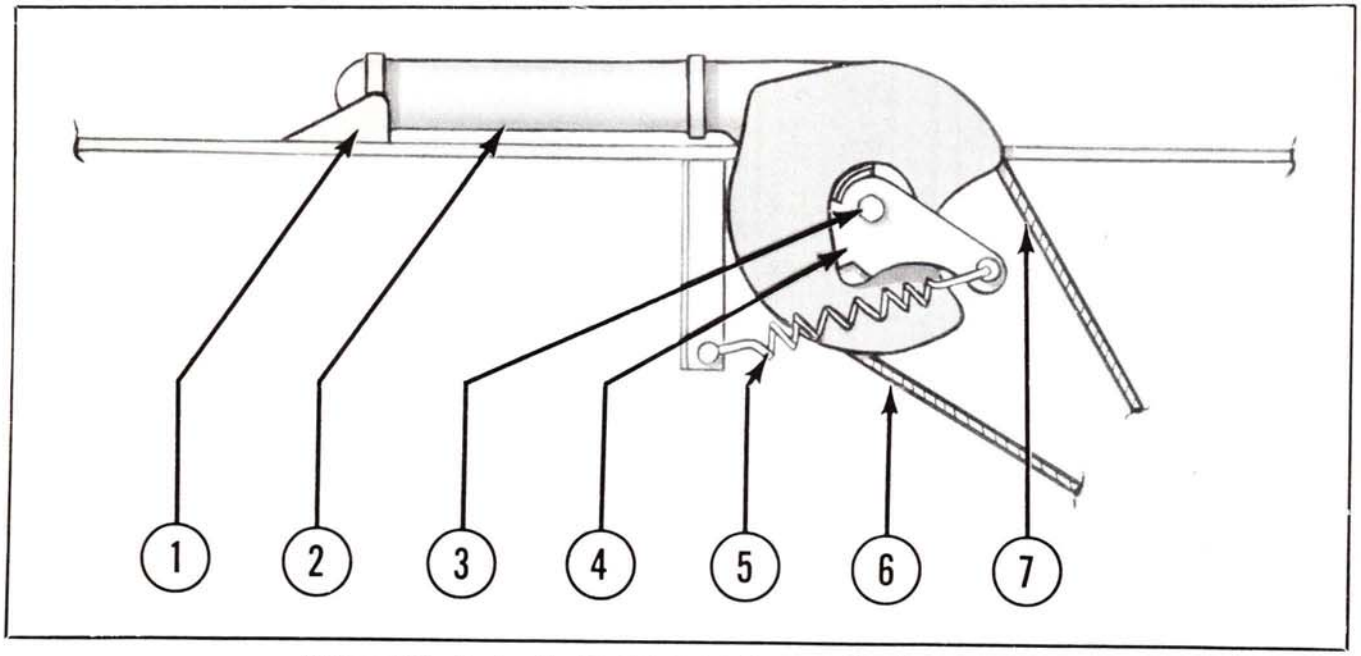


Figure 140—Mechanical Safety Latch Control Handle Assembly

(Douglas Dwg. No. 5110570)

Item	*Part No.*	*Part Name*	*No. Req*
1	1117057	Lock	1
	1117058	Support	1
	AF515-8-16	Screw	1
	AF365-D832	Nut	1
	AN515-8-29	Screw	2
	AAF365-D832	Nut	2
	1117038	Plate	1
2	2117377	Handle Assembly	1
	Consists of		
	4117379	Sheave	1
	2117377-1	Tube	1
	1117374	End	1
	1117375	Cover	1
	1117373	Button	2
	AN515-6-4	Screw	3
	AN935-6	Lock Washer	3
	AN515-6-24	Screw	1
	AF365-D632	Nut	1
	1117031-1	Cable Assembly	1
	1117031-3	Cable Assembly	1
3	1117059	Bolt	1
	1117060	Spacer	1
	124682-6D12-020	Washer	1
	KC-6	Fafnir Roller Bearing	2
	1117039	Spacer	1
	AN320-5	Nut	1
	AN380-2-2	Cotter	1
4	1117044	Stop	1
5	1117045	Spring	1
	AN520-10-6	Screw	1
	AN960-D10	Washer	1
	AF365-D1032	Nut	1
6	1117031-3	Cable Assembly	(Ref)
7	1117031-1	Cable Assembly	(Ref)

NOTE: Refer to section IX for cable fabrication information.

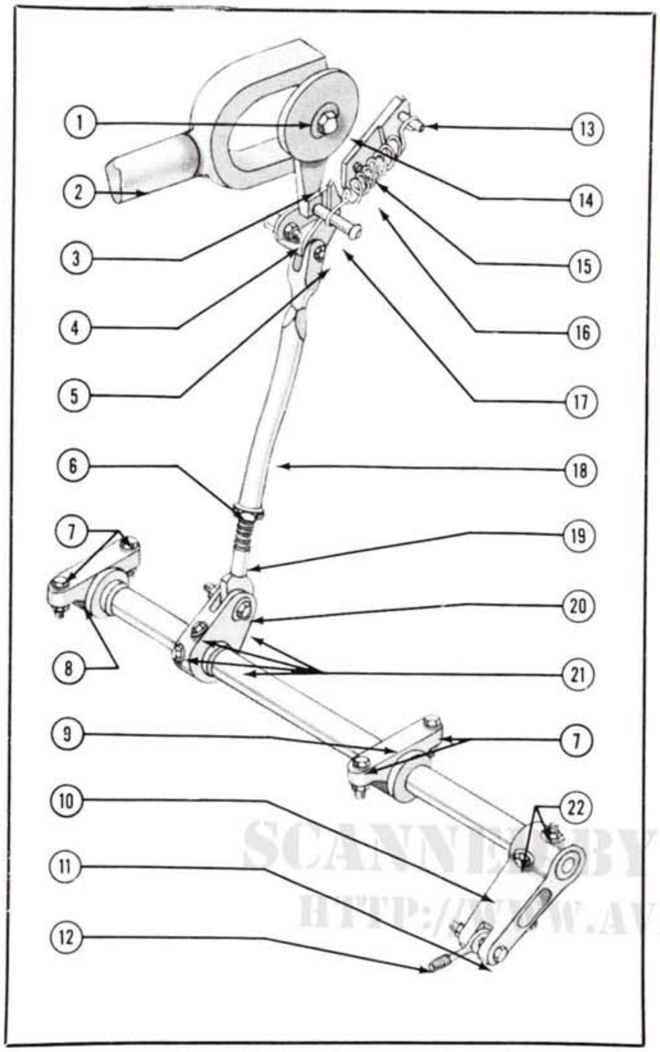


Figure 141—Mechanical Safety Latch—Torque Tube and Control Valve Mechanism

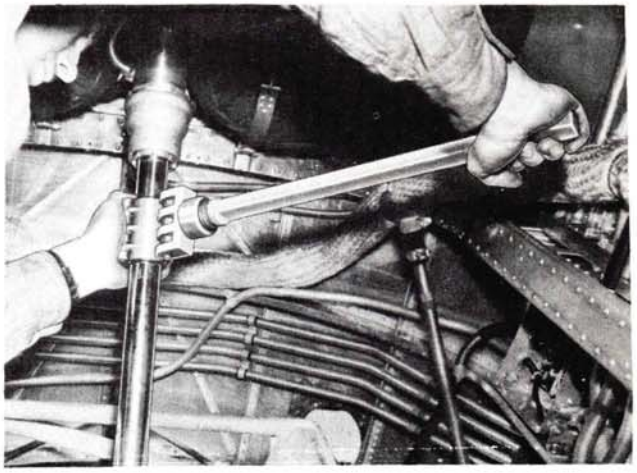


Figure 142—Use of Piston Rod Clamp (Service Tool No. K21714)

(4) SHOCK ABSORBER STRUT.
(See figure 397.)

(a) DESCRIPTION.—Each main landing-gear wheel is mounted between two pneumatic-hydraulic shock absorber struts, which absorb the landing and taxiing loads imposed on the airplane. Landing loads are absorbed mainly by forcing the hydraulic fluid in the strut through an orifice in the lower cylinder of the strut. Taxiing loads are absorbed mainly by the compression of the air in the upper chamber of the strut. The main landing-gear wheel axle is clamped on each end by the piston tubes of the two struts. Rigid bracing connect the upper ends of the two struts which are bolted to the upper truss. A triangular linkage system between the two shock struts and the rear brace strut maintains virtually vertical strokes of the shock

(Douglas Dwg. No. 5110570)

Item	*Part No.*	*Part Name*	*No. Req*
1	1117064	Bushing	1
2	2118951-1	Handle Assembly	(Ref)
3	1117062	Dog Assembly	1
4	AF365-428	Nut	1
	124682-6D10-064	Washer	2
5	AN4-7	Bolt	1
	AN310-4	Nut	1
	AN380-2-2	Cotter	1
6	AN315-6R	Nut	1
7	AN3-4A	Bolt	4
	AN960-10	Washer	4
	AF365-1032	Nut	4
8	1117042	Bearing Assembly	2
	Consists of		
	1117042-1	Housing	2
	1117042-2	Bushing	2
9	1117042	Bearing (See Item 8)	(Ref)
	143908-025D100-.032	Washer (Use as Necessary to Provide 1/32-inch Maximum Clearance.)	2
	143908-025D100-.064	Washer	1
	143908-025D100-.125	Washer	1

KEY TO FIGURE 141 (Continued)

Item	*Part No.*	*Part Name*	*No. Req*
10	1117041	Arm	1
11	AN23-7	Bolt	1
	AN310-3	Nut	1
	AN380-2-2	Cotter	1
12	AN165-8S	Pin Eye—RH	2
13	1117063	Shoe Assembly	1
14	1/4 x 28	Cap Nut	1
15	AN4-7A	Bolt	1
	AN960-416	Washer	1
	AF364-428	Nut	1
16	1117061	Spring	1
17	2133383	Cam Assembly	1
	Consists of		
	2133383-2	Cam	1
	A-304	Standard Oilite Bushing	1
	A-524	Standard Oilite Bushing	1
18	2117068	Rod	1
19	1117080	Eyebolt Assembly	1
	Consists of		
	1117080-1	Eyebolt	1
	1117080-2	Bushing (Make from A-304-2 Oilite)	1
20	AN4-13	Bolt	1
	AN310-4	Nut	1
	AN380-2-2	Cotter	1
21	2117067	Torque Tube Assembly	1
	Consists of		
	2131256	Tube	1
	1131255	Lever	1
	AN3-16A	Bolt	2
	AN960-10	Washer	2
	AN365-1032	Nut	2
22	AN960-10	Washer	2
	AN365-1032	Nut	2
	AN3-14A	Bolt	2

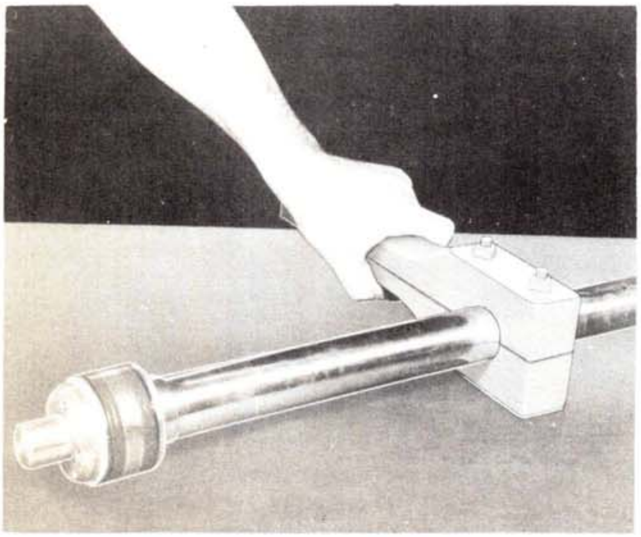


Figure 143—Substitute Landing-Gear Actuating Cylinder Piston Rod Clamp

struts. In flight, the struts are fully extended. A tube connects the two struts to aid in balancing the air pressure in the pair of struts. For complete information on the operation and component parts of the shock struts, refer to this section, paragraph 13.*c.*(5).

(b) REMOVAL.

1. Install ground safety pins in both landing-gear upper trusses. (See figures 130 and 131.)

2. Support the airplane on wing jacks as instructed in section III, paragraph 2.*b.*(1)*(a)*.

3. Release the air pressure in the shock struts by backing off one filler plug until all "fizzing" of air and oil in the struts ceases.

4. Disconnect and remove the balance line between the pair of struts.

5. Disconnect the rear brace strut from the shock struts.

6. Remove the axle clamp bolt from the strut to be removed.

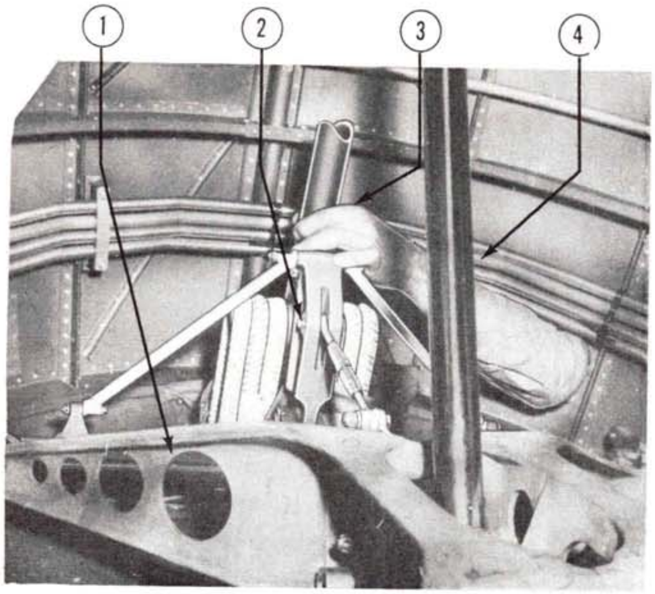


Figure 144—Installing Bungee Spreader Bar

1. Landing-Gear Upper Truss
2. Bungee Shock Cords
3. Bungee Spreader Bar
4. Landing-Gear Actuating Cylinder Piston Rod

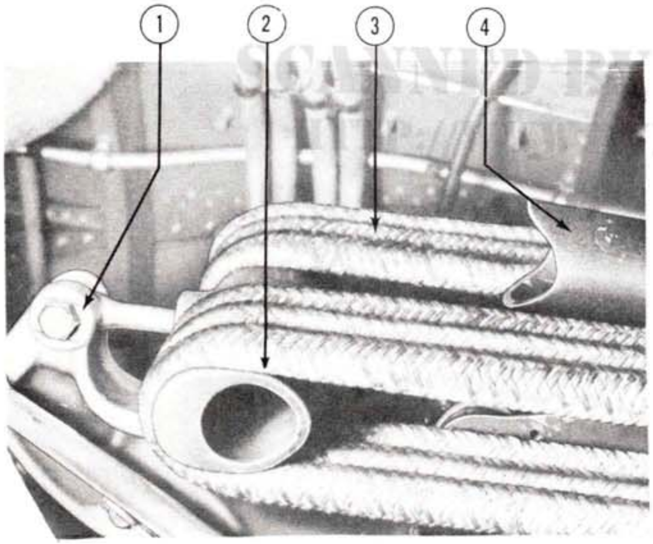


Figure 145—Bungee Spreader Bar in Place Before Retraction of Landing Gear

1. Bungee Forward Yoke Attaching Bolt
2. Bungee Forward Yoke
3. Bungee Shock Cords
4. Bungee Spreader Bar

7. Remove the bolt that connects the shock strut upper braces.

8. Remove the bolt that attaches the shock strut to the upper truss and remove the shock strut from the airplane.

9. Remove the upper brace, arms, and triangular links from the shock strut before disassembly.

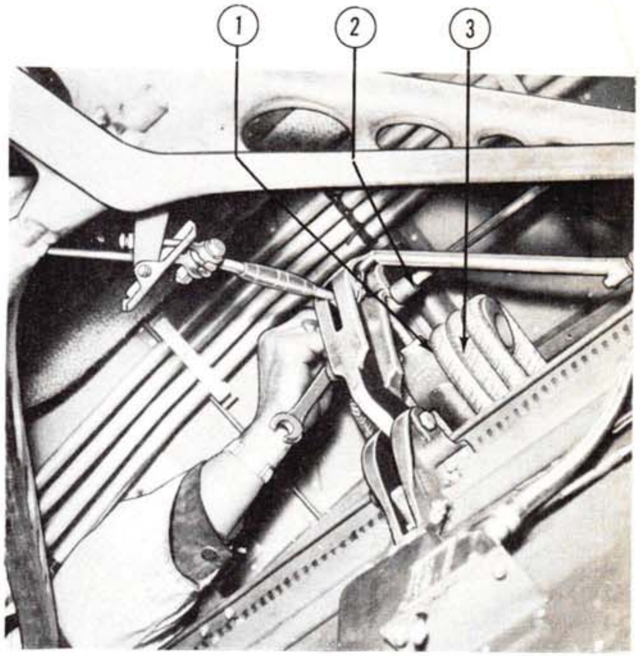


Figure 146—Removing Bolt From Bungee Forward Yoke

1. Bungee Forward Yoke
2. Socket Wrench
3. Bungee Elastic Shock Cords

(c) MAINTENANCE REPAIR OR REPLACEMENT.—For servicing instructions and maintenance repair or replacement procedure, refer to this section, paragraph 13.*c.*(5)*(c)*.

(d) INSTALLATION.

To install the shock strut, refer to figure 127 and reverse the removal procedure given in this paragraph *b.*(4)*(b)*.

(5) BUNGEE AND HYDRAULIC COMPENSATOR.

(a) BUNGEE. *(See figure 128.)*

1. DESCRIPTION.—The bungee, used on earlier airplanes, consists of six loops of elastic shock cord mounted on a forward yoke that is connected to the upper truss by a rod and on an aft yoke mounted in the rear of the nacelle. The bungee cords are extended by the extension of the landing gear and aid in balancing the weight of the landing gear. The bungee also assists the landing-gear actuating cylinder to retract the landing gear. The date of manufacture of the bungee may be determined by the colored threads in the outer cover; two threads for year, one thread for quarter, as follows:

Year Identification	
2 Blue	1939
2 Yellow	1940
2 Green	1941
2 Red	1942
2 Blue (or Orange)	1943
2 Yellow	1944
2 Black	1945
2 Green	1946
2 Red	1947

Quarterly Identification	
1 Red	January-March
1 Blue	April-June
1 Green	July-September
1 Yellow	October-December

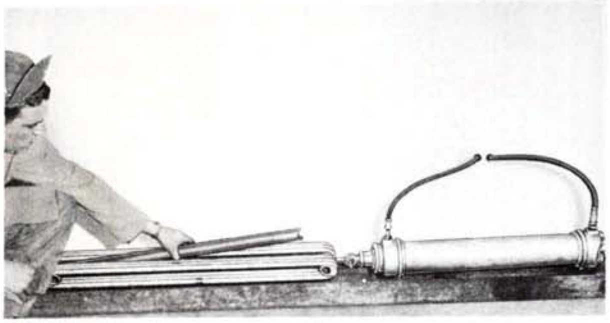


Figure 147—Spreading Bungee With Hydraulic Jack

Note

For succeeding years and quarters this cycle repeats.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—Extreme care must be observed when removing or installing the bungee because the high tension of the cords can cause accidents resulting in damage to the airplane and serious injury to personnel. When the bungee is removed, observe the following procedure:

(1) Fabricate a bungee spreader bar as shown in figure 85.

(2) Support the airplane on wing jacks, as outlined in section III, paragraph 2.*b.*(1)*(a).*

(3) With the landing gear extended, place one end of the spreader bar on the center of the bungee rear yoke. The bungee spreader bar may be placed on the yoke by working through the access doors on each side of the upper portion of the nacelle. (See figure 144.)

(4) Reduce the hydraulic system pressure to zero by operating the wing flaps. Move the safety latch control handle to the "LATCH RAISED" position and the landing-gear control valve handle to the "UP" position.

(5) Retract the gear slowly by operating the hydraulic hand pump until the forward end of the spreader bar engages the bungee forward yoke, relieving the tension on the bungee yokes. (See figure 145.)

(6) Place the landing-gear control valve handle in the "NEUTRAL" position.

(7) Remove the bolts that attach the bungee yokes and remove the spreader bar, shock cord, and fittings as a unit. (See figure 146.) Lower the gear slowly or support it from the ground or the landing gear will drop rapidly with the bungee removed.

(8) Use a chain hoist, hydraulic jack, or other suitable power equipment and stretch the shock cords sufficiently to free the spreader bar. (See figure 147.) Remove the spreader bar.

(9) Relieve the tension on the shock cords. The bungee yokes and fittings then may be removed from the shock cords.

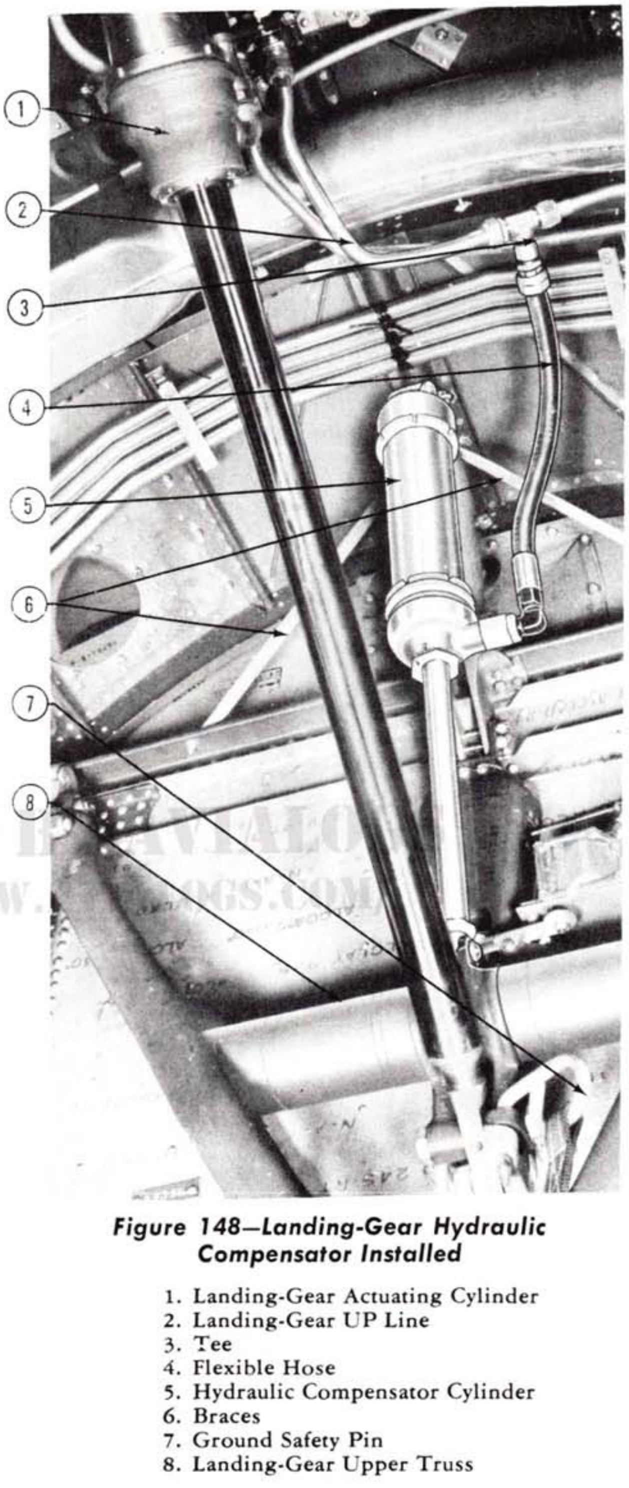


Figure 148—Landing-Gear Hydraulic Compensator Installed

1. Landing-Gear Actuating Cylinder
2. Landing-Gear UP Line
3. Tee
4. Flexible Hose
5. Hydraulic Compensator Cylinder
6. Braces
7. Ground Safety Pin
8. Landing-Gear Upper Truss

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Do not spray gasoline into the nacelle wheel wells because gasoline has a deteriorating effec on rubber and will greatly shorten the service life o the bungees.

b. Visually inspect the shock cords at each 50-hour inspection period and replace whenever necessary. Cord showing marked irregularity in diameter is

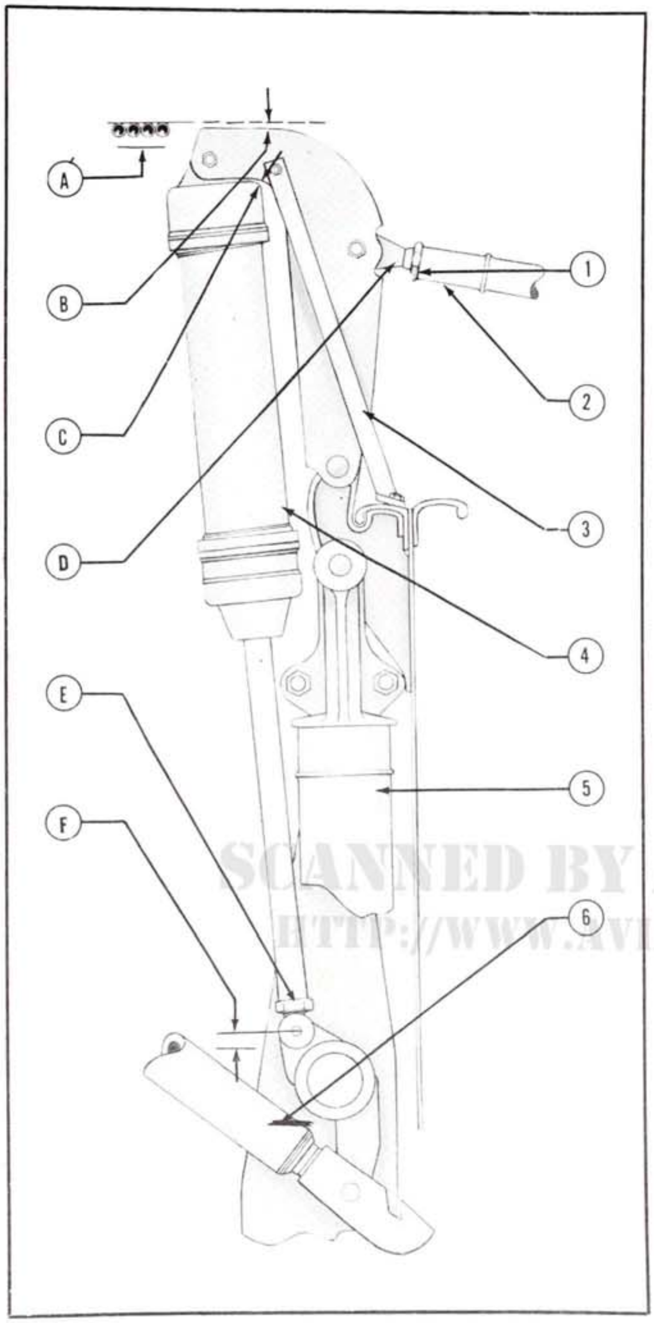


Figure 149—Landing-Gear Hydraulic Compensator Adjustments

- A. 1/8 inch Minimum Clearance Between Vacuum Lines in Nacelle and Cylinder Cap When the Landing Gear is Fully Retracted
- B. 1/16 inch Minimum Clearance
- C. 1/16 inch Minimum Clearance
- D. Bolt
- E. Piston Rod End—Compensator Cylinder
- F. 1/8 inch Overtravel of Compensator Piston Rod
  1. Lock Nut
  2. Rod Assembly
  3. Brace—Install Square Ends Up
  4. Landing-Gear Hydraulic Compensator Cylinder
  5. Landing-Gear Upper Truss
  6. Landing-Gear Actuating Cylinder Piston Rod

considered defective. Shock absorber cord which is more than 3 years old is unsatisfactory for service and is to be replaced.

4. ASSEMBLY AND INSTALLATION.—To assemble and install the bungee, reverse the procedure outlined in this paragraph, *b.*(5)*(a)2.*

(b) HYDRAULIC COMPENSATOR.
(See figure 148.)

1. DESCRIPTION.—On later airplanes, the landing-gear bungee was replaced by a hydraulic compensator to aid the landing-gear actuating cylinder in providing quick retraction of the landing gear. The compensator is a hydraulic cylinder that is bolted to a bracket on the wing front spar with the cylinder piston rod attached to the landing-gear upper truss. A flexible hose connects the lower end of the compensator to the landing-gear hydraulic "UP" line. When the landing gear is retracted, hydraulic fluid under pressure flows into the lower end of the compensator, retracting the cylinder piston. The retracting compensator piston assists in retracting the landing gear. When the landing gear is extended, the compensator piston is extended by the weight of the gear and the hydraulic fluid in the compensator flows into the landing-gear hydraulic "UP" line and returns to the hydraulic reservoir. Refer to paragraph 13.*c.*(4)*(a)* for a complete description of the hydraulic compensator.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—Refer to this section, paragraph 13. *c.*(4)*(b)1.* for removal instructions.

b. DISASSEMBLY.—Refer to this section, paragraph 13.*c.*(4)*(b)2.* for disassembly instructions.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Refer to this section, paragraph 13.*c.*(4)*(c).*

4. ADJUSTMENTS.—There are two points of adjustment on the hydraulic compensator installation: The bolt that attaches the rod to the mounting bracket (D, figure 149), and the piston rod end of the compensator cylinder (E, figure 149). Observe the following procedure when installing the compensator:

a. If the mounting bracket and rod have been removed, check the clearance between the bracket and hat section (B, figure 149). Adjust the bolt to obtain a minimum of 1/16-inch clearance. When the proper clearance is obtained, secure the bolt with the lock nut.

b. Attach the compensator cylinder to the bracket and upper truss and check the cylinder upper end and the bracket (C, figure 149) for a minimum of 1/16-inch clearance. The clearance at "B" and "C" (figure 149) may be equalized by adjustment of the bolt at "D" (figure 149). A minimum of 1/16-inch clearance must be obtained at both "B" and "C" (figure 149).

c. Remove the bolt that attaches the compensator piston rod to the upper truss. Check the

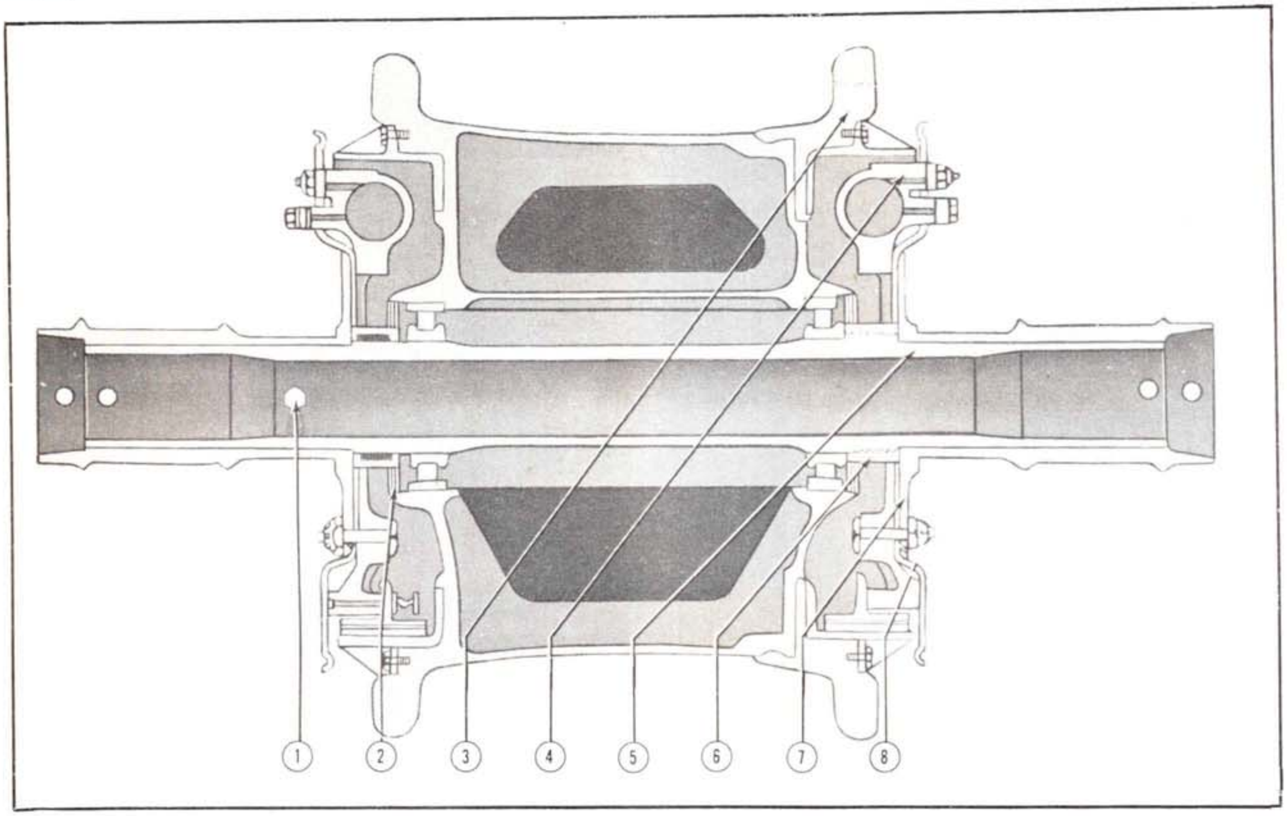


Figure 150—Landing-Gear Wheel and Axle Assembly

HTTP://WWW.

(Douglas Dwg. No. 5116415)

1. AN8-36 Bolt, 143908-016 S-028-063 Washer, AN310-8 Nut, and AN380-3-3-Cotter (2 each req)
2. 143908-300S320-063 Washer (1 req) and 143908-300S320-032 Washer (1 req) (Use as necessary to center wheel)
3. Bendix B-3 or B-1 17:00 x 16 Wheel
4. Bendix Duo-Servo Brake
5. 5116596 Axle Assembly
6. 51023 Bendix—Adjusting Collar (Axle Nut)
   51226 Bendix—Collar Retaining Screw
   51021 Bendix—Lock Washer
   NOTE: Requisition item 6 parts under Bendix Assembly No. 57396
7. 5111575 Brake Torque Collar (2 req)
8. AN9-15 Bolt (10 req)
   AN9-17 Bolt (4 req)
   AN310-9 Nut (14 req)
   AN960-916 Washer and AN380-4-4-Cotter (14 each req)

piston rod for 1/8-inch overtravel. The cylinder must have 1/8-inch overtravel to prevent bottoming of the piston. (F, figure 149).

d. In the fully retracted position, the forward travel of the compensator cylinder is approximately 11 inches. In this position check "A" (figure 149) for 1/8-inch minimum clearance between the cylinder upper end and the vacuum line assembly in the upper nacelle.

e. When the compensator cylinder has been adjusted properly, install the bolt that attaches the piston rod to the upper truss.

5. ASSEMBLY AND INSTALLATION.

a. ASSEMBLY.—Refer to figure 398 and section IV, paragraph 13.*c.*(4) *(f)1.* for assembly instructions for the hydraulic compensator.

b. INSTALLATION.—To install the compensator reverse the removal procedure outlined in this section, paragraph 13.*c.*(4)*(b)1.*

(6) WHEELS, BRAKES, AND AXLES.
(See figure 150.)

(a) GENERAL.—Bendix cast aluminum-alloy wheels complete with 14 x 3 duo servo hydraulic brakes, are installed on the main landing-gear axles. The wheels are equipped with 10-ply, 45 x 17 tires, type I inner tubes. A flight wheel brake (figure 180) is installed on the aft face of each fire wall to prevent the wheels from turning in flight.

(b) WHEELS.

1. DESCRIPTION.—The main landing-gear wheels, interchangeable right and left, are of the flap base, rim-type and are cast from aluminum alloy. The wheel consists of three major parts: the wheel casting, the demountable rim flange, and the brake drums. The split-type demountable rim flange is attached to the wheel casting by a key and special locking bolts and nuts. The wheels are of the dual-brake type and one forged steel brake drum is mounted in each side of the wheel by nine drum mounting bolts. The wheels are equipped with Timken roller bearings.

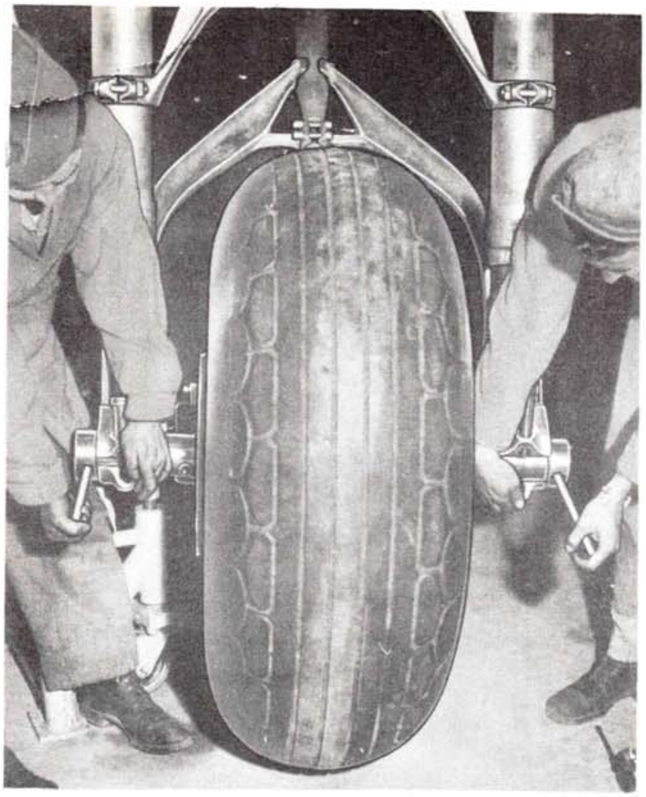


Figure 151—Installing Axle Clamp Bolts

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL (USING WING JACKS).

(1) Support the airplane on wing jacks, as instructed in section III, paragraph 2.*b.*(1)*(a).*

(2) Reduce the hydraulic system pressure to zero by operating the wing flaps. Move the safety latch control handle to the "LATCH RAISED" position and the landing-gear control valve handle to the "UP" position. Make certain that the hand pump to pressure accumulator shut-off valve is "CLOSED." Retract the gear about 6 inches by operating the hydraulic hand pump.

(3) Return the landing-gear control valve handle to "NEUTRAL."

(4) Disconnect the flexible hydraulic hoses leading to the brake actuating cylinders. (See figure 154.)

(5) Unscrew the axle clamp bolt nuts. Raise the axle by means of bars through the holes in the ends of the axles and remove the axle clamp bolts. (See figure 151.)

(6) Roll the wheel and axle assembly from beneath the shock struts. (See figure 152.)

b. REMOVAL (USING WHEEL JACKS).

(1) Raise the wheels evenly about 3 inches by using wheel jacks, as instructed in section III, paragraph 2.*b.*(1)*(c).*

(2) Disconnect the flexible hydraulic hoses leading to the brake actuating cylinders. The wheels may be removed for tire servicing without disconnecting the brake hydraulic hoses by observing the following procedure:

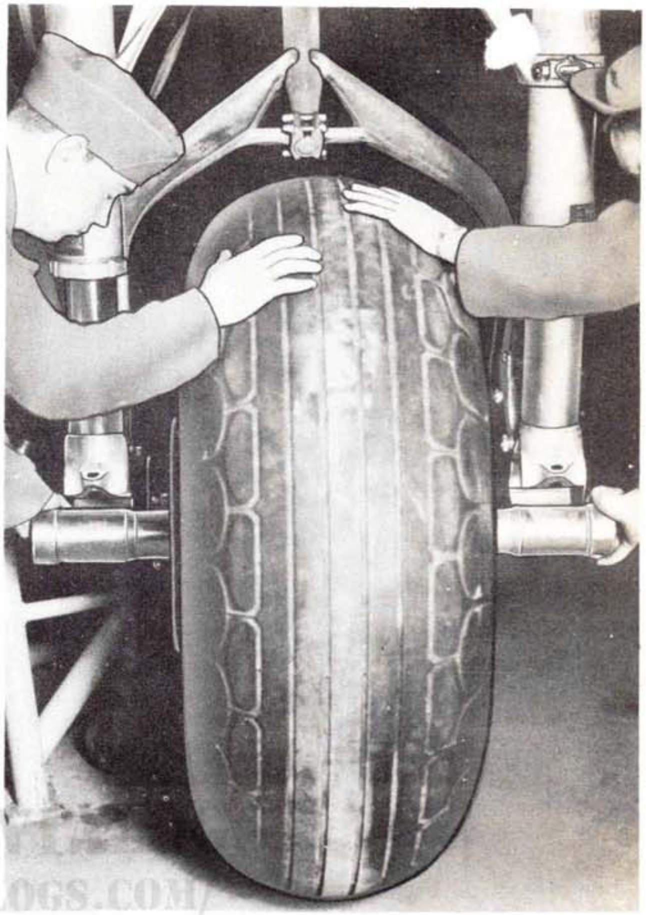


Figure 152—Placing Wheel and Axle Assembly Under Shock Strut Clamps

(a) Unscrew the axle clamp bolt nuts. Raise the axle by means of bars through the holes in the ends of the axles (figure 151) and remove the axle clamp bolts.

(b) Turn the wheel and axle assembly so that the brake torque collar and brake assembly can be removed from the axle after removing the brake torque collar attaching bolt (figure 160).

(c) After both brake torque collar assemblies have been removed from the axle and placed on a clean support, roll the wheel and axle assembly from beneath the shock struts.

(d) If the brake hydraulic hoses are not disconnected, bleeding of the brakes is unnecessary when the wheel is reinstalled.

(3) Unscrew the axle clamp bolt nuts. Raise the axle by means of a bar through the holes in the ends of the axles and remove the axle clamp bolts. (See figure 151.)

(4) Roll the wheel and axle assembly from beneath the shock struts.

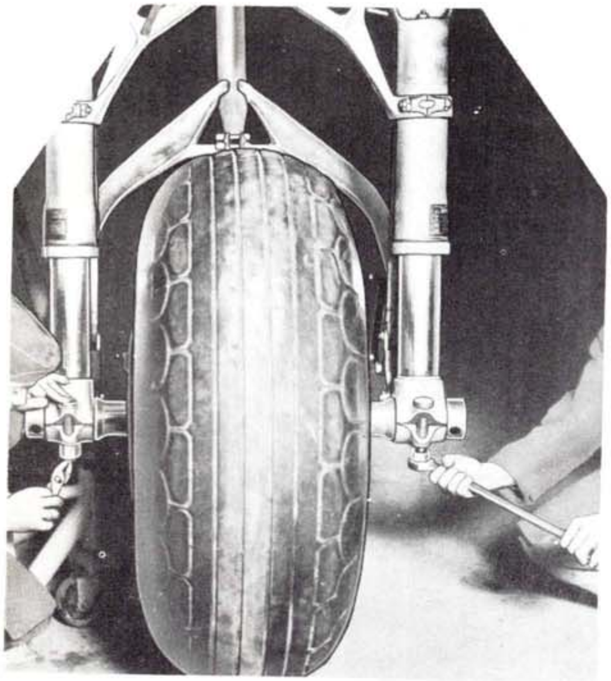


Figure 153—Tightening and Safetying Axle Clamp Bolts

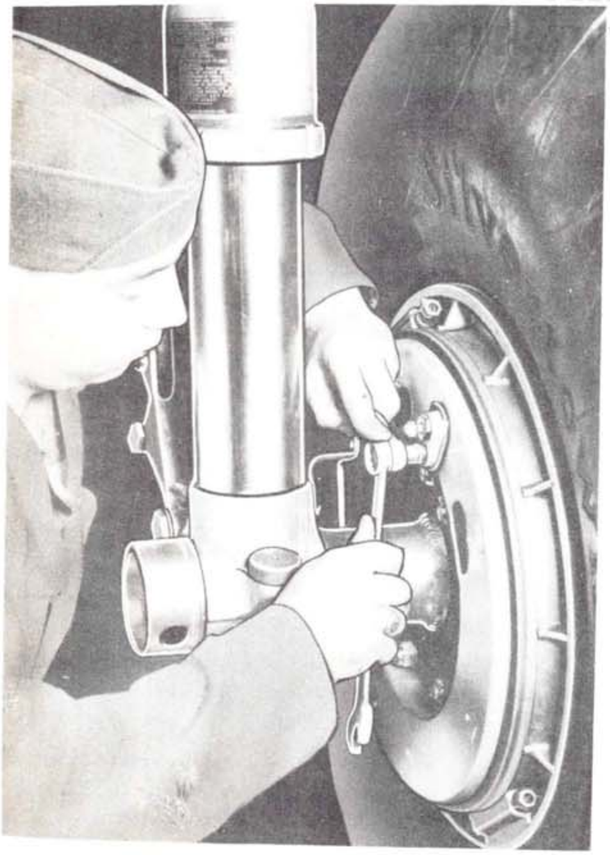


Figure 154—Tightening Brake Hydraulic Hose Connection

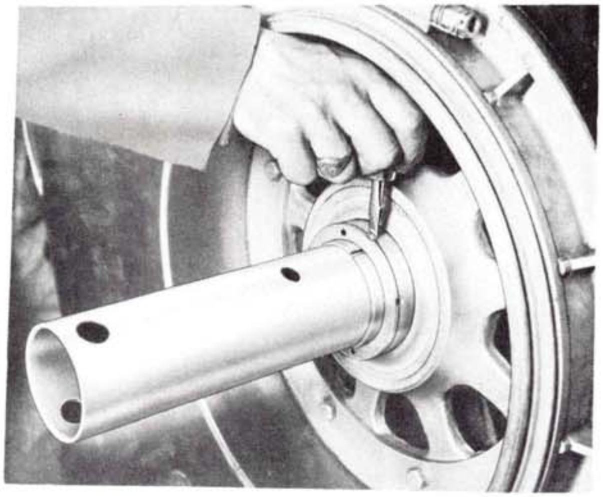
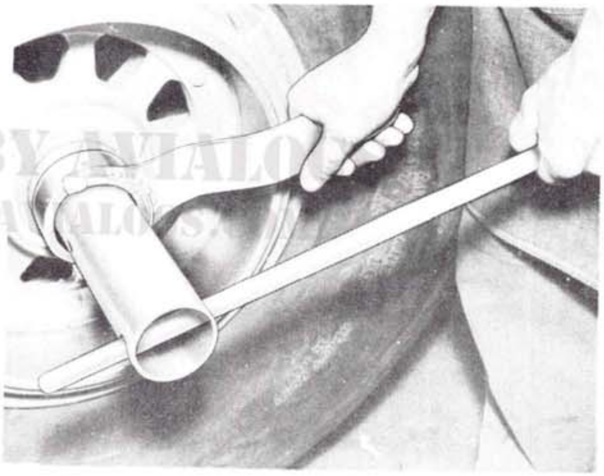


Figure 155—Removing Main Landing-Gear Axle Nut Lock Screw



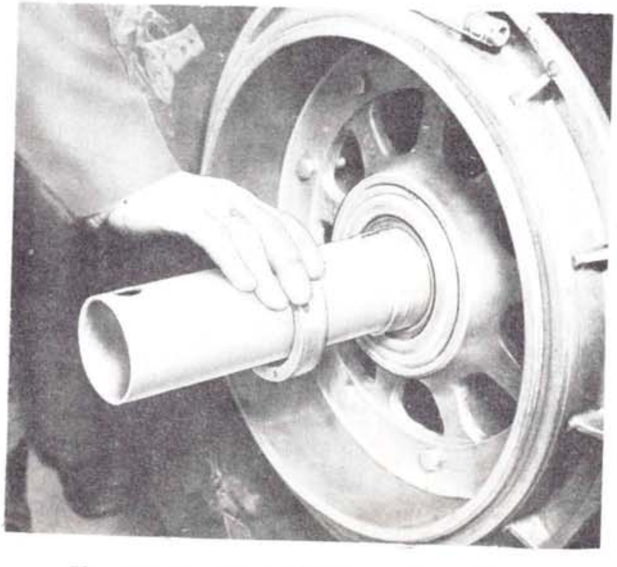


Figure 156—Use of Main Landing-Gear Axle Nut Wrench (Service Tool No. K20101)

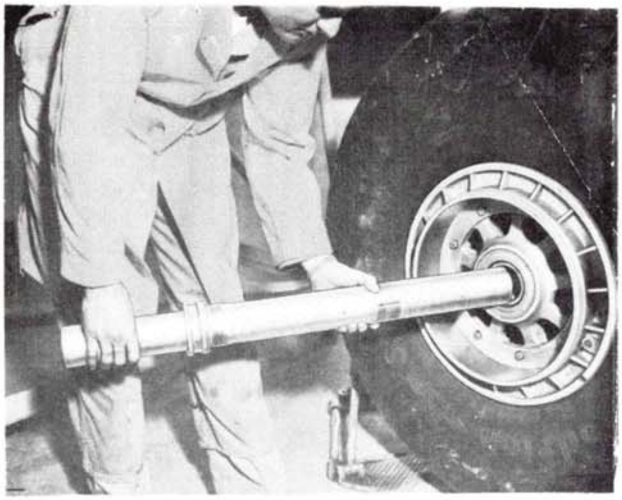


Figure 157—Removing Axle From Wheel

c. DISASSEMBLY.

(1) Remove the brake torque collar bolts (figure 160) and slide each brake and torque collar assembly as a unit from the axle (figure 161).

(2) Remove lock wire and remove lock screw from the main landing-gear axle nut (figure 155) and remove the axle nut (figure 156) by using service tool (K20101), which may be fabricated according to figure 86.

(3) Slide the axle out of the wheel (figure 157).

(4) Remove the snap ring (figure 158) and remove the bearing grease retainers and bearing (figure 159).

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. The wheels should be inspected daily for bent or distorted rims. Inspect the wheels for security of retaining nuts, bolts, and cotters.

b. Remove burs and indentations from wheel castings with a flat file.

c. Remove cracked or loose bearing cups from the wheel with a hand arbor press, if available, or by driving out with a hammer and brass bar. Use light hammer blows and move the driving bar about one-third the circumference of the bearing cup between blows.

d. Install new bearing cups, using a hand arbor press. Before attempting to insert the bearing cup, heat the wheel to approximately 82°C (180°F) either in an oven or by immersing in hot water. NEVER expose the wheels to an open flame.

e. If a standard bearing cup does not fit securely in the wheel, it may be necessary to install slightly oversize bearing cups. If oversize cups are not available, shims may be inserted under the bearing cup as needed to make it secure.

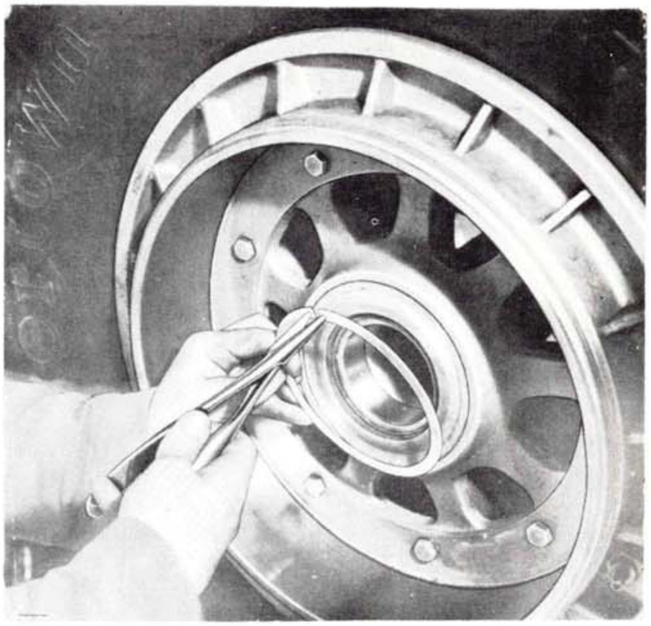


Figure 158—Removing Bearing Retaining Snap Ring

f. Clean wheel bearings thoroughly with solvent, Federal Specification No. P-S-661, and allow to dry or blow out with a dry air blast. Prevent the bearings from revolving by the use of an air blast. Inspect the bearings for roughness and replace if necessary. Lubricate the bearings every 100/120 hours with grease, **Specification No. MIL-L-3545. (See figure 84.)**

g. Replace all grease retaining parts with new parts.

h. Check carefully the condition of the paint on the wheels and for any evidence of corrosion. Corrosion of the wheel parts occurs very rapidly unless the surfaces are well protected. If the paint has deteriorated and the wheel surface is exposed, repaint the wheel as follows:

(1) Remove old paint with acetone, Federal Specification No. O-A-51A, or paint remover.

(2) Protect bearing cups, drums, and other friction surfaces by masking.

***(3)* Apply one coat of zinc chromate primer, Specification No. MIL-P-6889a. Apply two coats of aircraft enamel, Specification No. MIL-E-7729 (aluminum enamel obtained by mixing from 1½ to 2 pounds of aluminum-bronze powder per gallon of varnish).**

i. Clean any corroded area carefully and examine to determine the extent of corrosion. Any other condition than surface corrosion is cause for replacement of the part.

j. Inspect the brake drums. Replace them if they are out of round, scored, or corroded sufficiently to disturb braking operation. Replace the brake drums if they are cracked at bolt holes, or heat checked excessively on the braking surface. If brake drum holes are elongated more than 1/32 over their original diameter, replace the drums.

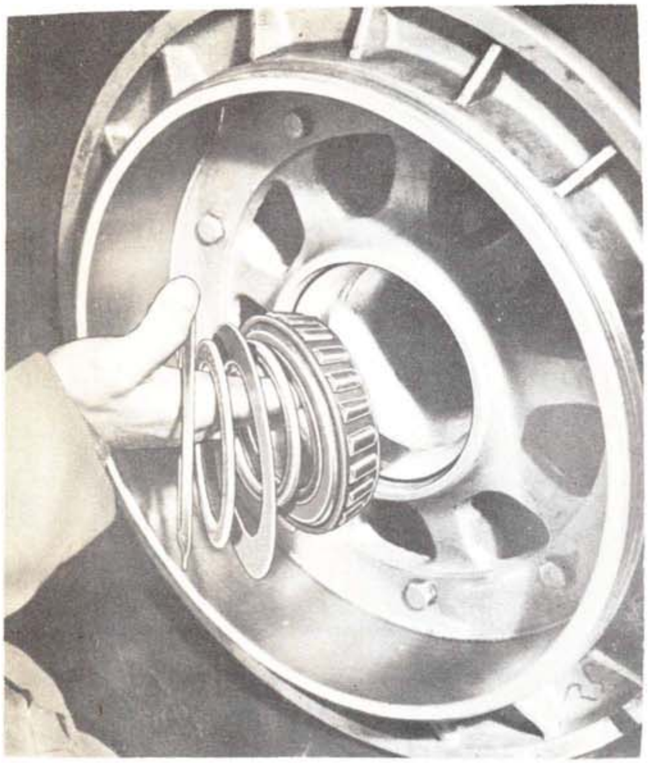


Figure 159—Removing Wheel Bearing and Grease Retainers

k. Check for cracked wheel castings, especially at the following locations: fixed rim flange, spokes, and brake drum stud bosses. Replace all cracked castings with new parts.

l. Wheels having loose flange locking keys, or stripped threads in stud bolt holes, are to be repaired at a depot.

m. Replace the demountable rim flange if the castings are cracked.

4. ADJUSTMENTS.—Adjustment of the main wheel roller bearings must be made carefully by observing the following procedure:

a. Use an axle nut wrench, service tool (K20101) (figure 156) to tighten the main landing-gear axle nut until a bearing drag is noticed when spinning the wheel by hand.

b. Back off the nut until the wheel will revolve freely without bearing drag. Tighten the axle nut lock screw and safety with lock wire. Check the wheel for side play after making the adjustment.

5. ASSEMBLY AND INSTALLATION.

a. ASSEMBLY.—The wheel is positioned on the axle by means of 1/32-inch shims placed between the fixed collar of the axle and the bearing of the wheel as follows:

(1) Install three 1/32-inch spacers between the fixed axle collar and the wheel.

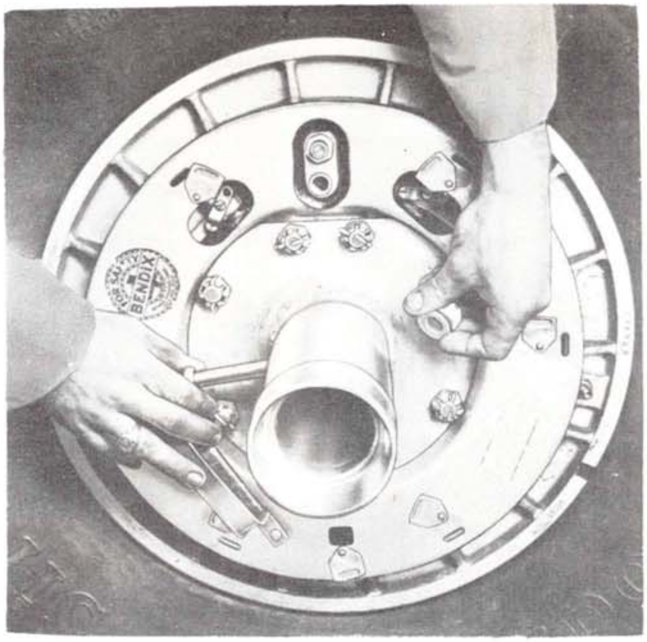


Figure 160—Removing Brake Torque Collar Attaching Bolt

(2) Mount the wheel and bearing assembly on the axle with the fixed end of the wheel against the fixed axle collar.

(3) Install the lock washer and axle nut (adjustable collar).

(4) Tighten the axle nut until a bearing drag is noticed when spinning the wheel by hand. Then back off the nut until the wheel will turn freely without bearing drag.

(5) Tighten the axle nut setscrew and safety with lock wire.

(6) Place both brake and brake torque collar assemblies in position on the axle.

(7) Check the spacing of the brakes by checking the clearances between the inside face of the dust cover and the outside edge of the brake drum at each end of the wheel. If this spacing is not the same at both ends of the wheel, and if it is less than 3/32 inch or more than 3/16 inch, the wheel and axle must be disassembled and 1/32-inch shims added or removed from the fixed axle collar to obtain the proper spacing of the wheel.

(8) When the wheel is properly spaced on the axle, bolt the brake and brake torque collar assemblies on the axles.

b. INSTALLATION (USING WING JACKS).

(1) Install, but do not tighten, the brake torque collar bolts. Install the torque collar bolts with the heads of the bolts adjacent to the brake hose guide. (See figure 160.)

(2) Move the wheel into position directly beneath the shock strut clamps (figure 152) with the removable flange of the wheel outboard or inboard. Move the

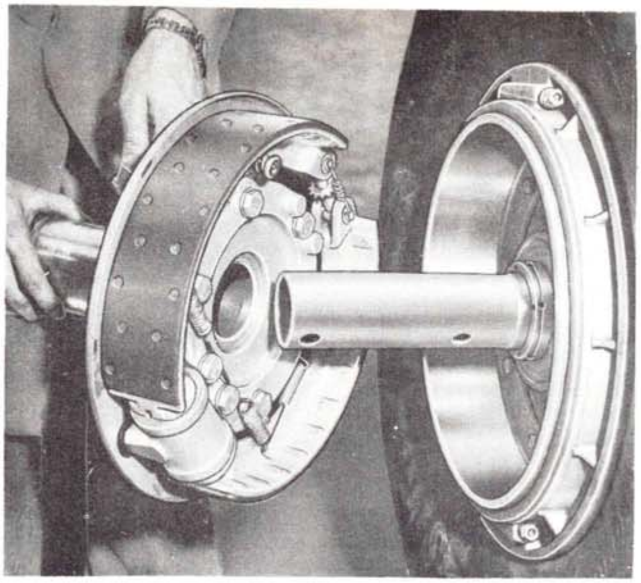


Figure 161—Removing Torque Collar and Brake Assembly From Axle

landing-gear control valve handle to the "DOWN" position and extend the landing gear slowly by operating the hydraulic hand pump until the shock strut piston clamps engage the axle.

CAUTION

> Make certain that the keys in the shock strut piston clamps are engaged in the keyways in the brake torque collars. These keys transmit the braking torque and if they are not in place, complete failure of the brakes results.

(3) Install the axle clamps, bolts, and nuts (figure 153). Tighten the axle clamp bolts to a torque of 2160 ± 240 inch-pounds. Install cotters.

(4) Tighten and safety the brake torque collar bolts.

(5) Connect the brake hydraulic lines (figure 154) if the hoses were disconnected. Bleed the brakes, if necessary, as instructed in section IV, paragraph 13.*d.*(2)*(d)*. If brake self-sealing couplings are installed, it should not be necessary to bleed the brakes.

(6) Make certain that the landing gear is latched down and ground safety pins are installed in the landing-gear upper trusses before removing the wing jacks, as instructed in section III, paragraph 2.*b.*(1)*(a)*.

c. INSTALLATION (USING WHEEL JACKS).

(1) Completely assemble wheel, axle, and brakes and brake torque collars, but do not tighten the brake torque collar bolts.

(2) Lift wheel assembly into place with bars through the holes in the ends of the axle (figure 151) and install the axle clamp bolts and nuts. Be sure that the keys in the shock strut piston clamps are engaged in the brake torque collar keyways. Tighten the axle clamp bolts to a torque of 2160 ± 240 inch-pounds and safety (figure 153).

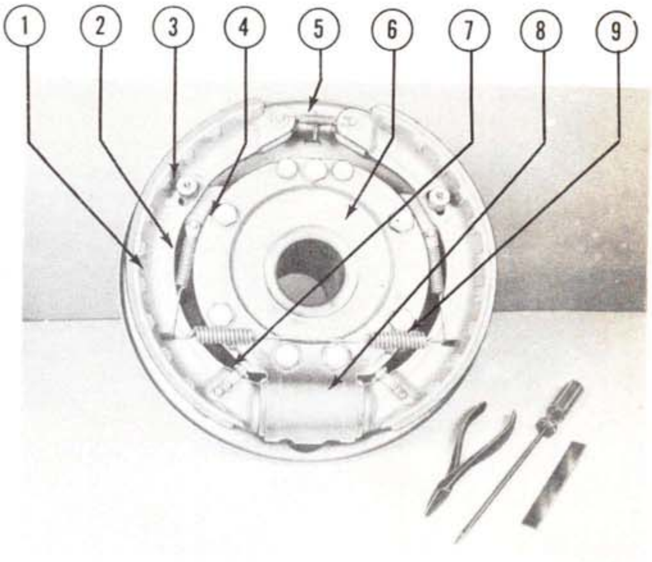


Figure 162—Brake Assembly Complete

1. Brake Shoe
2. Brake Shoe Pull-Down Spring
3. Brake Shoe Hold-Down Spring Assembly
4. Attaching Bolt—Brake Spider and Torque Collar
5. Balance Spring and Star Wheel Adjusting Screw
6. Brake Spider
7. Major Adjusting Screw
8. Brake Actuating Cylinder
9. Brake Shoe Return Spring

(3) Connect the brake hydraulic lines and bleed the brakes, as instructed in paragraph 13.*d.*(2)*(d)*. If self-sealing couplings are installed on the brake hoses, it should not be necessary to bleed the brakes.

(4) Make certain that the landing gear is latched down and that ground safety pins are installed in the upper trusses before removing the wheel jacks, as instructed in section III, paragraph 2.*b.*(1)*(c)*.

(c) BRAKES. *(See figure 162.)*

1. DESCRIPTION.—Hydraulically actuated, dual duo-servo brakes are installed in each main landing-gear wheel. Each brake is bolted to a brake torque collar which is bolted to the main wheel. The essential parts of the duo-servo type brake are as follows:

a. The torque spider (figure 162), the main structural part of the brake, includes a hydraulic cylinder which is open at both ends. Two holes in the cylinder wall lead to threaded bosses, one for attachment of the hydraulic lines and the other to permit bleeding of the brake system. A series of holes, equally spaced, permit bolting of the spider to the brake torque collar.

b. Two identical brake shoe and lining assemblies (figure 162) are nonrigidly fixed about the brake spider to allow for a full floating shoe ring.

c. Two brake piston and cup assemblies

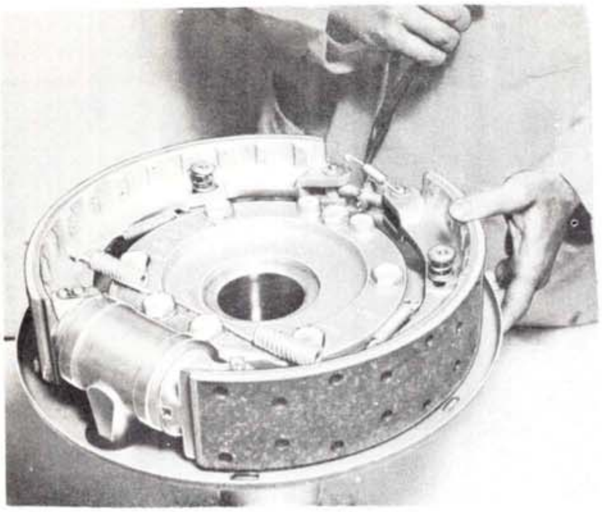


Figure 163—Removing Brake Shoe Balancing Spring

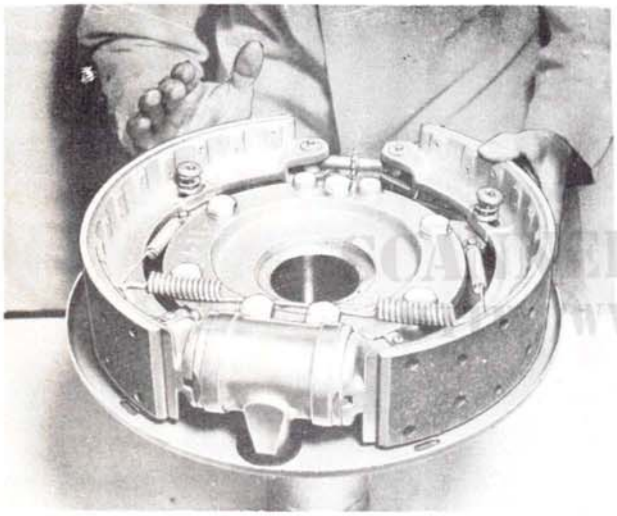


Figure 164—Striking Right Brake Shoe

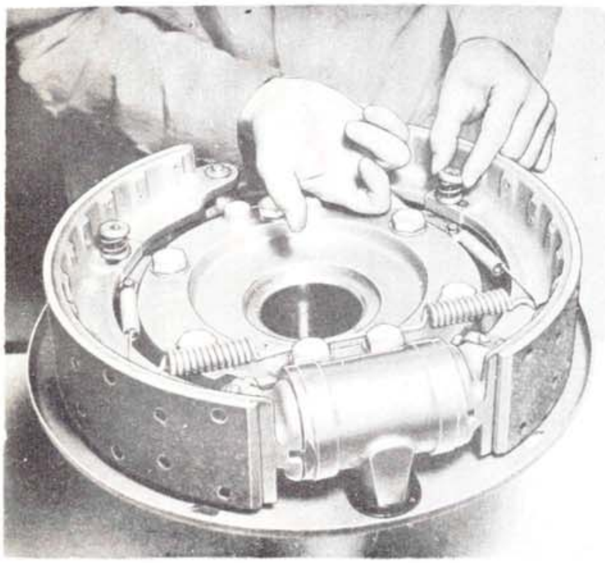


Figure 165—Removing Brake Shoe Hold-down Pin

(figure 162) are installed in the hydraulic cylinder. The outer ends of each piston are undercut to a rounded cross section to accommodate the bearing pin on the anchor caps.

d. Two anchor caps (figure 171) are provided, one for each piston. One end of the cap forms a rounded pin which fits into the recess in the brake piston. The other end of the anchor cap is designed with a tapered flange or key which fits into a groove machined into the end faces of each brake shoe.

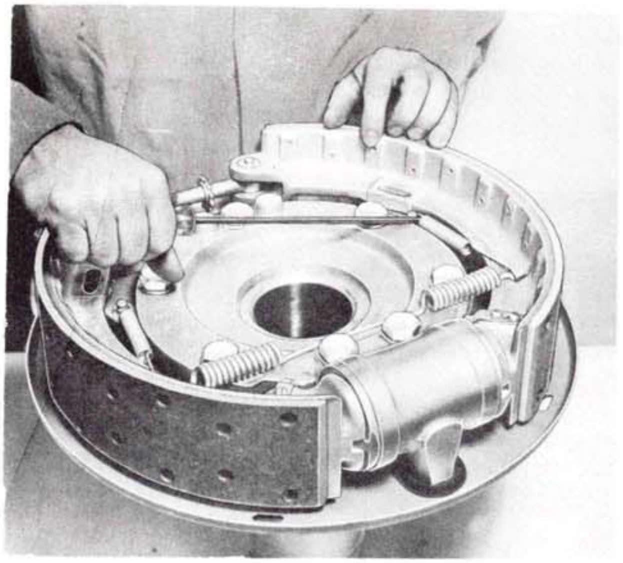
e. The star wheel adjusting screw (figure 162) has a right-hand thread on one side and a left-hand thread on the other. This screw attaches the lower ends of the shoes together by screwing into pivot nuts fitted into the end of each shoe.

f. Each shoe is provided with a major adjusting screw (figure 162) installed near the operating end of the shoe. This screw fits into the threaded bosses provided on each shoe and the head of the screw bears against the flat surface on the brake spider.

g. A shoe return spring (figure 162), two shoe pull-down springs, two shoe hold-down springs, and a balance spring are installed on the brake.

h. A stamped metal dust cover is attached to the outside of the brake. The cover is provided with inspection slots for checking and setting brake adjustment, and holes for the hydraulic fluid line bosses on the brake spider.

i. The duo-servo brake is designed to utilize the servo principle in building up braking force in that the forward motion of the wheel is utilized to aid the operator in applying the brakes. The operation of the brakes is as follows: When toe pressure is applied to the rudder-brake pedals, the brake control valve is actuated and hydraulic fluid under pressure is directed to the brake actuating cylinder. (Refer to paragraph 13.*d.*(2) for a complete description of the brake hydraulic system and operation of the brake control valve.) The hydraulic fluid under pressure forces the brake actuating pistons to move outward and this outward force is transmitted to the brake shoes by the anchor caps. Both brake shoes simultaneously are forced into contact with the brake drum. The friction force in direction of wheel rotation which is built up on one shoe, which acts as the primary shoe, is transmitted to the other shoe by the star wheel adjustment screw. The servo action of the primary shoe on the other shoe, acting as the secondary shoe, is built up rapidly and the secondary shoe tends to move in the direction of wheel rotation. The servo action takes place immediately after brake application; therefore, in effect, only one piston acting on the primary shoe causes actuation of the brake. Duo-servo brakes operate equally well in either direction of wheel rotation. When toe pressure on the rudder-brake pedal is released, the brake shoes are immediately snapped to the full "OFF" position by the shoe return spring and held in this position by the return spring and shoe hold-



Figue 166—Removing Brake Shoe Pull-down Spring

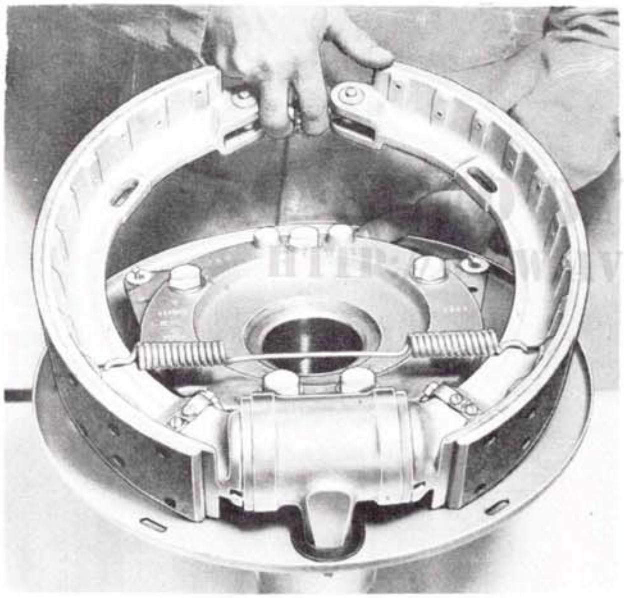


Figure 167—Lifting Brake Shoe

down springs. The excess hydraulic fluid in the brake cylinder flows through the brake operating line to the brake control valve and into the return line to the hydraulic reservoir.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—To remove the brake and torque collar assembly, observe the procedure outlined in this paragraph, *b.*(6)*(b)2*. Care must be taken to prevent hydraulic fluid from flowing onto the brake lining.

b. DISASSEMBLY.

(1) Remove the balancing spring as shown in figure 163.

(2) Strike the right brake shoe (figure 164) to obtain clearance to remove the left shoe hold-down spring.

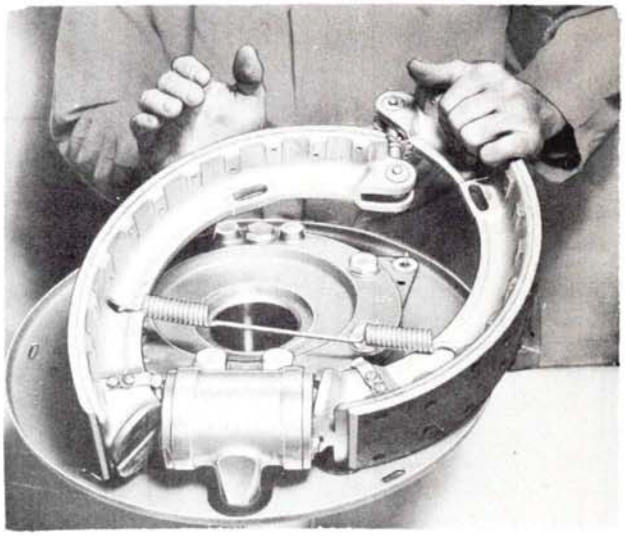


Figure 168—Collapsing Brake Shoes

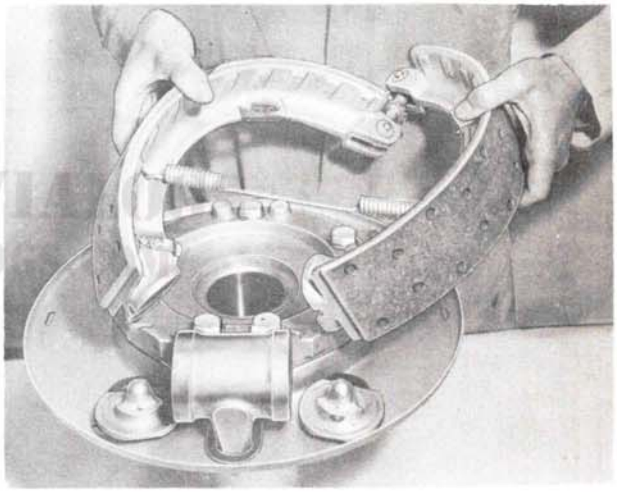


Figure 169—Removing Brake Shoe

(3) Remove left hold-down spring (figure 165). Strike the left brake shoe and remove the right hold-down spring.

(4) Remove the brake shoe pull-down springs as shown in figure 166.

(5) Lift the brake shoes (figure 167) and collapse the shoe ring, as shown in figure 168.

(6) Remove the brake shoes, as shown in figure 169. The anchor caps will drop free.

(7) Remove the actuating piston and cup assemblies as shown in figure 170 and the brake will be disassembled (figure 171). Care should be observed to prevent foreign particles from entering the brake cylinder during disassembly.

(8) If necessary, the brake spider can be removed from the brake torque collar by removing the attaching bolts.

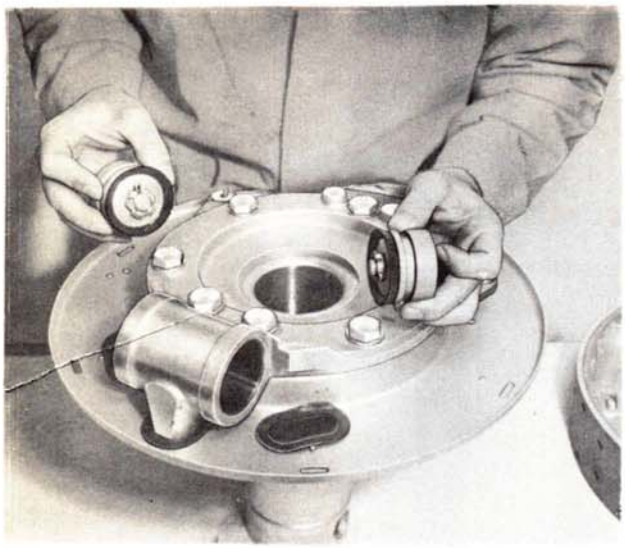


Figure 170—Removing Brake Actuating Pistons

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Small dents or creases or slight distortions of the brake dust cover may be removed by placing the cover on a wooden block and hammering slightly with a rubber mallet.

b. Corroded areas on the dust cover are cleaned carefully and repainted.

c. If the torque spider is slightly corroded or paint is worn off in spots, carefully clean and repaint the spider.

d. Brake shoes also should be cleaned and repainted as necessary. Slight amounts of grease or oil on the brake lining may be removed with a high-grade gasoline.

e. Unserviceable or faulty brake springs and shoe hold-down pins should be replaced with new parts.

f. Replace bent, distorted, or worn star wheel adjustment screws with new parts.

g. If evidence of leakage of hydraulic fluid from the brake actuating cylinder is found, the cylinder will be repaired as follows:

(1) Inspect the piston and cup assemblies and cylinder walls for scoring. Pistons showing evidence of scoring are replaced with new parts and piston cups always are replaced.

(2) If the cylinder walls are scored, install a new spider and send the faulty spider to a depot for repair.

(3) If no scoring of the cylinder walls is found, reassemble the brake cylinder with new cups installed on the pistons.

Note

Check the dust cover for —65° in yellow letters, denoting that winterized piston cups are installed in the brakes.

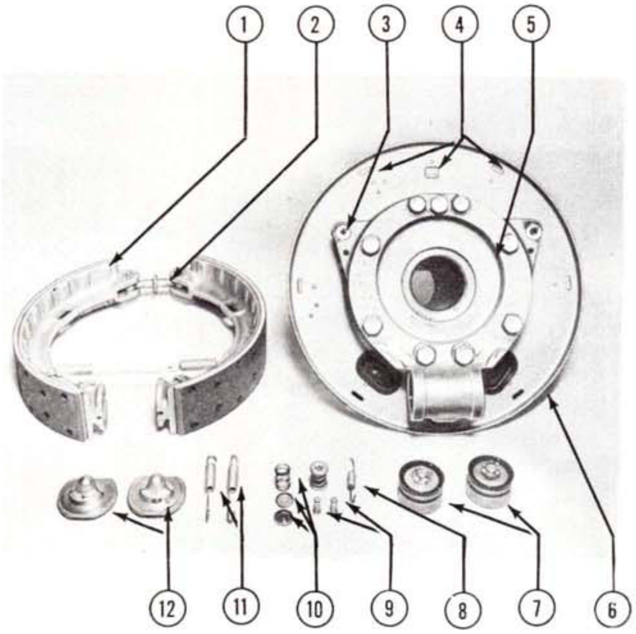


Figure 171—Brake Disassembled

1. Brake Shoe Assembly
2. Star Wheel Adjusting Screw
3. Brake Shoe Hold-Down Pin
4. Inspection Slots
5. Brake Torque Spider
6. Dust Cover
7. Piston and Cup Assemblies
8. Balance Spring
9. Pull-Down Spring Pins
10. Hold-Down Spring Assembly
11. Brake Shoe Pull-Down Springs
12. Anchor Caps

(4) Use the brake drum as a fixture to hold the brake assembly while testing the brake cylinder for leaks. It will not be necessary to adjust the brake in performing this check other than that necessary to allow entry of the brake within the drum.

(5) Apply 5 psi fluid pressure to determine any leakage at low pressure. Apply 1000 psi fluid pressure. If fluid leakage is detected, replace the brake with a new part and send the damaged spider to a depot for repair. If no fluid leakage is observed, the brake is satisfactory.

(6) Paint all nonfriction surfaces not previously painted with one coat of approved primer.

h. Send brake drums needing regrinding or repairs to a depot for disposition. To remove the brake drum from the wheel, remove the bolts that attach the drum to the wheel. Force the drum from the wheel. If necessary, place a bar against the lip of the drum and use a hammer to drive out the drums. Move the driving bar about one-third the circumference of the drum between blows.

i. To install new brake drums, insert long

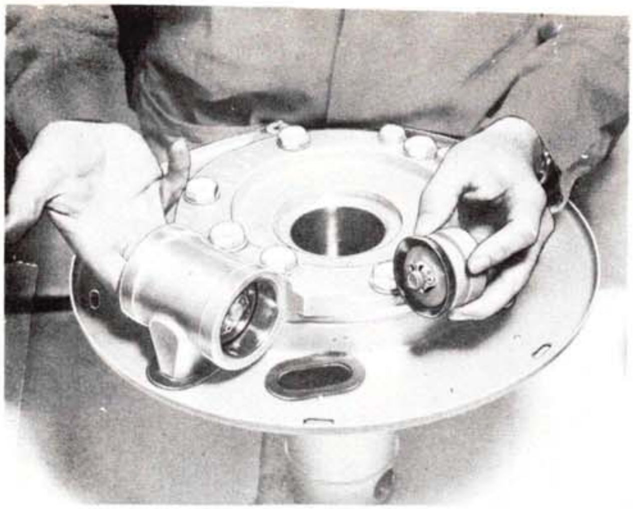


Figure 172—Installing Piston and Cup Assemblies

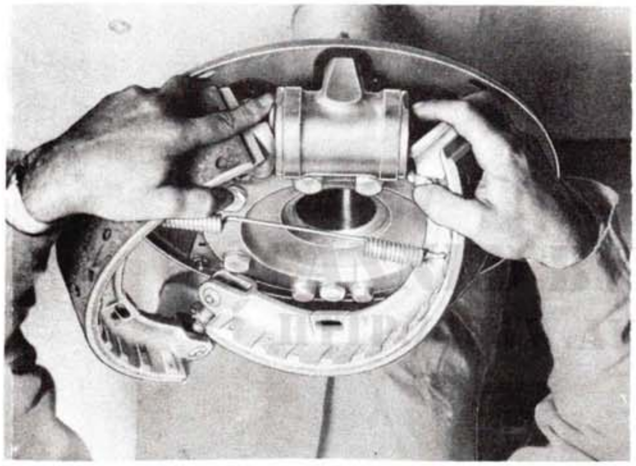


Figure 173—Installing Brake Shoes on Spider

rods through the brake drum mounting bolt holes. Heat the wheel with steam or by immersion in a tank of hot water. Slide drum over rods and into place in the wheel. Install drum mounting bolts and nuts. Tighten the bolts solidly, then back them off one-quarter turn.

4. ADJUSTMENTS.

a. BRAKE ADJUSTMENT. (See Figure 179.)

(1) To perform the brake adjustment, place short jacks under the main wheel axle as shown in figure 36, and raise the airplane just sufficiently to permit the wheel to rotate. Since the duo-servo brake has a full floating shoe ring, it is necessary to use four thickness gages, one at each of the four slots, "A" and "B" and "Z" and "S" to prevent shifting of the brake shoe ring during brake adjustment. For proper functioning of the brake, the clearance at all four slots must be equal. This should be the primary aim of the brake adjustment.

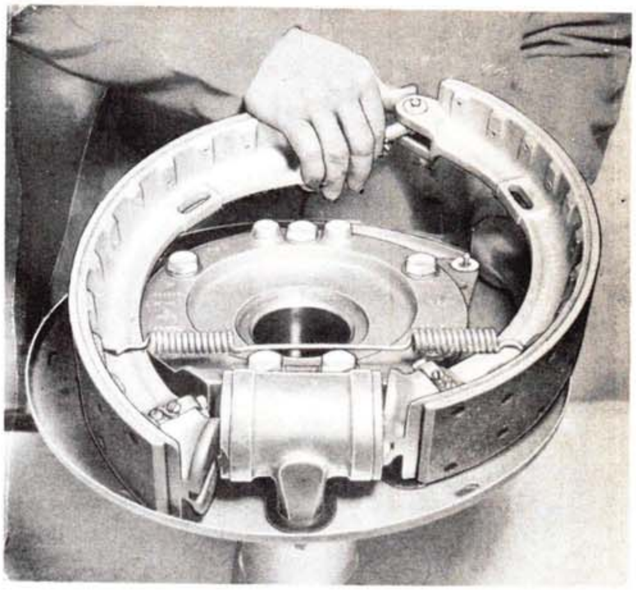


Figure 174—Extending Brake Shoes

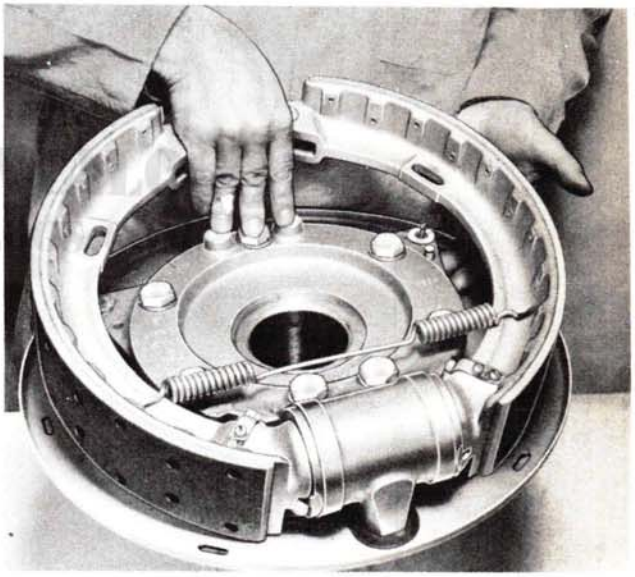


Figure 175—Installing Brake Shoe Ring

(2) As a primary point in adjusting the Duo-Servo brake, it is suggested that, with the brake installed in the brake drum the star-wheel (2) be rotated until the brake is dragging.

(3) Set the tentative equal clearance of .010 inch at (S) and (Z) by adjustment of the major adjusting screws (1) and (3), (Figure 179).

(4) By rotating the star-wheel (2), endeavor to set the same clearance at (A) and (B) as was obtained at (S) and (Z). If this cannot be done, it will be necessary to readjust the clearances at (S) and (Z).

(5) The desired brake clearance is .010 inch. This clearance should be uniform and equal at all four slots simultaneously.

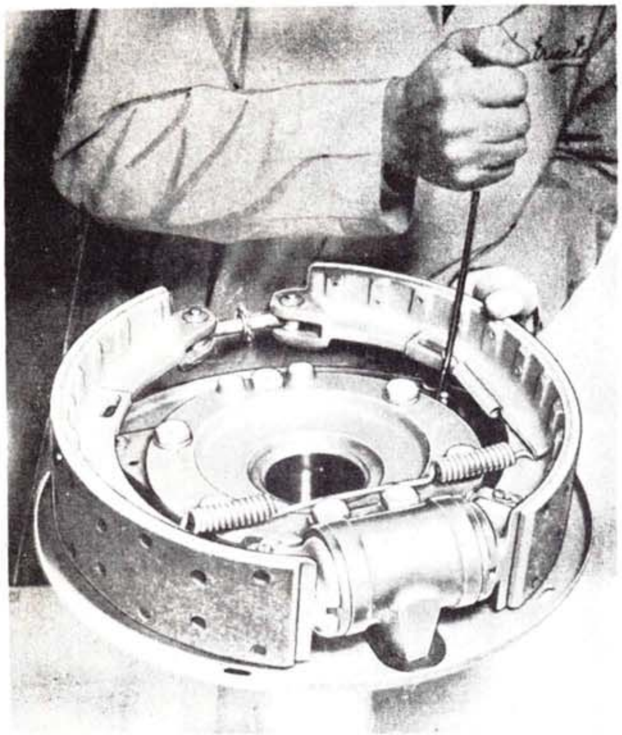


Figure 176—Installing Brake Shoe Pull-down Spring

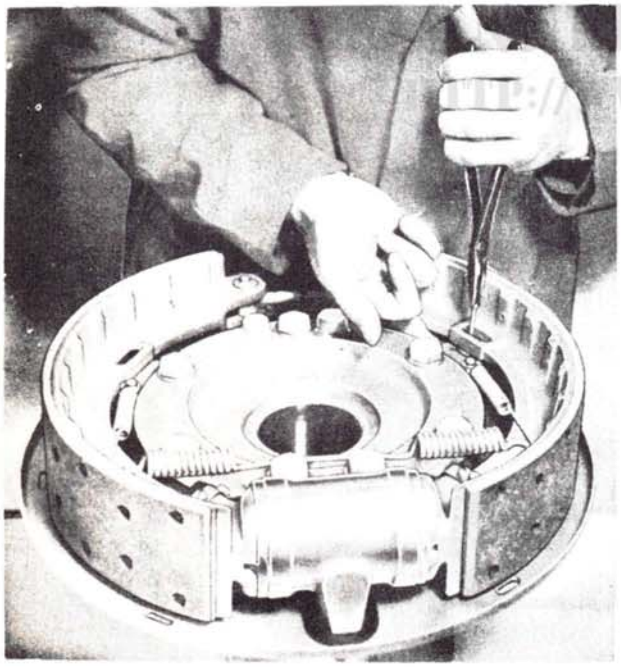


Figure 177—Installing Brake Shoe Hold-down Pin

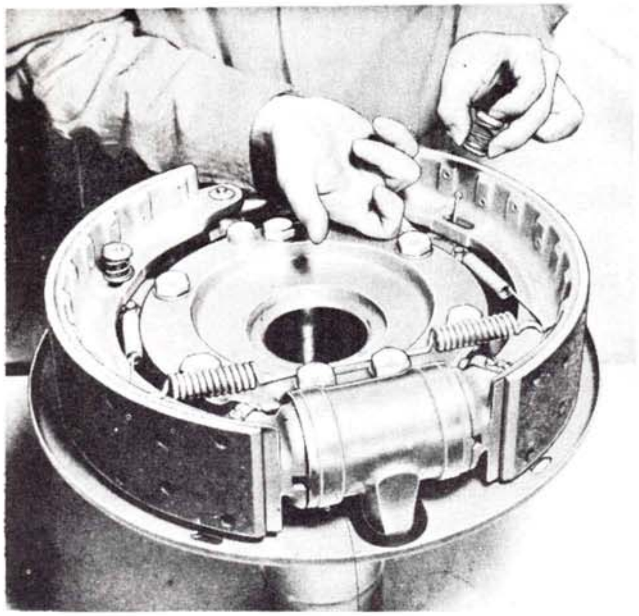


Figure 178—Installing Brake Shoe Hold-down Spring

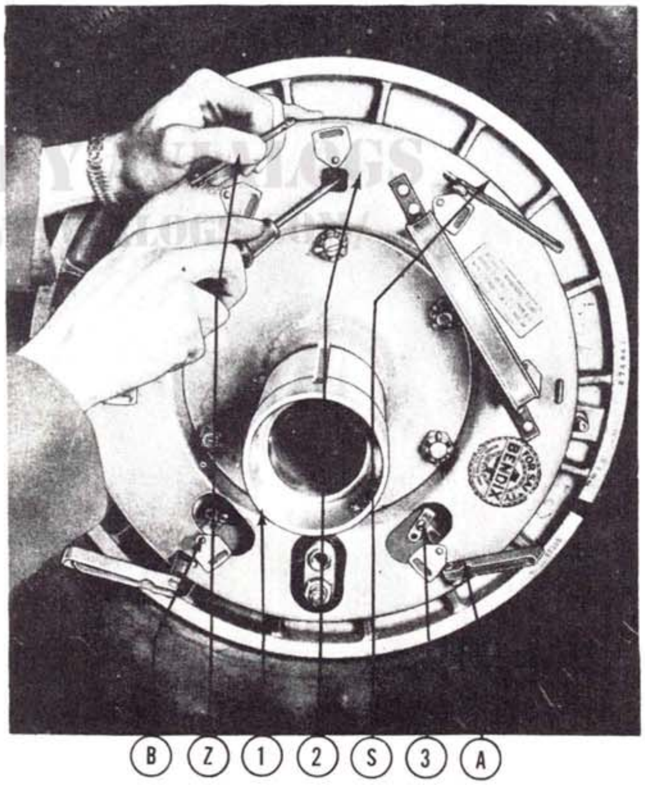


Figure 179—Adjusting Brake Shoes

1. Major Adjusting Screw
2. Star Wheel Adjusting Screw
3. Major Adjusting Screw

"B," "Z," "S," and "A" are feeler gages in locations specified in text.

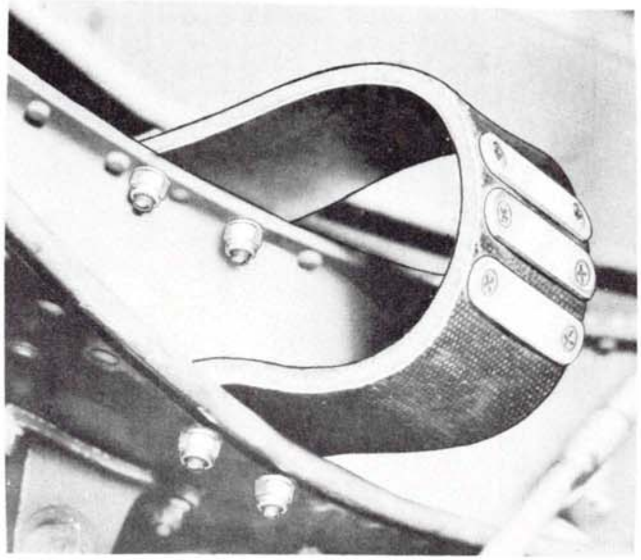


Figure 180—Flight Wheel Brake Installed

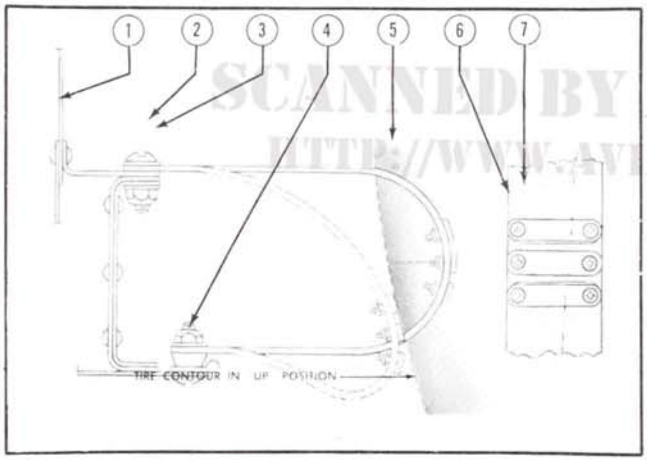


Figure 181—Flight Wheel Brake Assembly

b. BLEEDING OF BRAKES.—Refer to this section, paragraph 13.*d.*(2)*(d)1.* for instructions for bleeding the brake hydraulic system.

c. ADJUSTMENT OF BRAKE CONTROL VALVE.—Refer to this section, paragraph 13.*d.*(2)*(d)* for adjustment procedure of the brake control valve.

5. ASSEMBLY AND INSTALLATION.

a. ASSEMBLY.—Be sure all brake parts are clean before assembly. Prevent the entrance of any foreign material in the brake actuating cylinder.

(1) Install the piston and cup assemblies in the brake cylinder (figure 172). Be sure the brake bleeder valve is open when installing the pistons.

(2) Install the anchor caps and brake shoes (figure 173) on the torque spider.

(3) Extend the shoe ring (figure 174) and force down the shoe ring (figure 175).

(4) Install the brake shoe pull-down springs (figure 176).

(5) Install the brake shoe hold-down springs (figures 177 and 178). Place the balancing spring on the brake shoes.

b. INSTALLATION.—The spacing of the brakes and wheels is an exacting procedure and care must be observed so that interference of brake and wheel does not occur. Carefully observe the procedure given in this paragraph *b.*(6)*(b)5.*

(d) AXLES. *(See figure 150.)*

1. DESCRIPTION.—The main landing-gear wheel axles are made in one piece of heat-treated chrome-molybdenum steel tubing and are interchange-

(Douglas Dwg. No. 4115223)

Item	*Part No.*	*Part Name*	*No. Req*
1		Rear Face of Fire Wall	(Ref)
2	AN526-1032-14	Bolt	4
	AN526-1032-16	Bolt	4
	AN960-10	Washer	8
	AC365-1032	Nut	8
3	4115223-2	Plate (5/8 x 2 x .064-Inch Alclad 24 STAL)	4
4	4115223-3	Spacer (1039966-200)	2
5	4115223-1	2-Inch Wide Goodrich High Flexible Junior Medium Double Power Drive Belting	2
6	1087510-6-8	Screw	12
	AN960-6	Washer	12
	AAF365-632	Nut	12
7	4115223-4	2 x 1/2 x .094-Inch C.M. Steel Sheet	6

able right and left. The axle assembly incorporates a fixed collar while the adjustable collar (main wheel bearing retainer nut) is threaded on the axle.

2. REMOVAL.—To remove the axles, follow the instructions given in this paragraph *b.*(2)*(b)2.*

3. MAINTENANCE REPAIR OR REPLACEMENT.—If the main landing-gear wheel axle is damaged, it should be replaced with a new part. Replace the rubber bumpers in the nacelle landing-gear axle fittings every 200 hours.

4. INSTALLATION.—Refer to this paragraph *b.*(2)*(b)5.* for installation instructions.

(e) FLIGHT WHEEL BRAKE. *(See figure 181.)*

1. DESCRIPTION.—A flight wheel brake is attached to the rear face of the fire wall in each nacelle (figure 180) and consists of a length of heavy flexible belting fastened at each end to the fire wall and faced with small steel plates. When the landing gear is retracted into the nacelle wheel well, the brake automatically contacts the tire tread and causes sufficient braking action to stop the rotation of the wheel caused by the slip stream.

2. REMOVAL.—To remove the flight wheel brake from the airplane, remove the attaching bolts.

3. MAINTENANCE REPAIR OR REPLACEMENT.—If the belting of the flight wheel brake is cut or torn, new belting should be installed. Replace any defective steel plates on the belting.

4. INSTALLATION.—To install the flight wheel brake, refer to figure 181.

(7) TIRES AND TUBES.

(a) DESCRIPTION.—The main landing-gear wheels mount 10-ply, 45 x 17:00-16 tires, which encase 45 x 17:00-16 type I inner tubes.

(b) REMOVAL.

1. To remove the wheel assembly from the airplane, follow the procedure outlined in this paragraph *b.*(6)*(b)2.*

2. Remove the bolts that attach the brake torque collars and remove both brake torque collar and brake assemblies from the axle. (See figures 160 and 161.)

3. Remove the valve core and allow the tire to deflate completely.

4. Cut the safety wire and loosen the nuts that hold together the halves of the removable flange. The nuts cannot be removed completely until the tire bead has been forced off the bead seat edge of the flange.

5. The beads fit tightly on the tapered bead seats to prevent tire slippage. Use a heavy, wooden mallet and strike the casing side wall just above the rim of the removable flange, taking great care not to hit the flange.

6. When the bead has been broken loose, force the bead below the bead seat to free the removable flange. Remove the nuts and remove the flange.

7. Break loose the bead on the fixed flange side of the wheel.

8. After both beads are loosened, turn the tire up on the tread and locate the valve stem. Push the valve stem into the casing and behind one of the beads so that the stem will not catch on the wheel.

9. Two men are needed to work the wheel out of the casing. Sometimes it is necessary to use tire irons to assist the beads over ridges in the wheel. The ends of the tire irons must be kept in smooth condition to prevent damage to the casing or tube. Remove the wheel from the casing with an up and down motion. Remove the tube from the casing.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Correct inflation of the main landing-gear wheel tires is an important procedure in obtaining maximum wear from the tires. Overinflation results in excessive center tread wear while underinflation results in damaging the casing side walls. Inflate the tires by the deflection method. To maintain the proper deflection of the tire, various inflation pressures are necessary, according to the loading of the airplane. A deflection gage should be used when inflating the tires. If such a gage is not available, inflate the tires until the edge of the nonskid design or molded deflection marker barely touches the ground, with airplane resting on a smooth level surface. Check tire inflation daily.

2. Visually inspect the tire and wheel rims, without removing the casing, carefully checking for the following conditions:

a. When tread wear barely exposes the fabric of the casing, remove the casing from the wheel for recapping. Make frequent checks to determine the proper time to remove casings for recapping. Exercise care not to remove casings prematurely, particularly when considerable tread rubber remains.

b. If breaks, cuts, blisters, or other visible damage is detected, replace.

c. When casings show evidence of cupping from camber condition or toe-in, remove the casing and reverse on the same wheel.

d. When there is evidence of excessive corrosion on the visible outside portion of the wheel flange, remove the casing and inspect it for possible damage. Buff the flange thoroughly to remove all traces of corrosion. If the metal of the wheel is exposed, paint must be applied as directed in this paragraph *b.*(6)*(b)3.*

e. If the wheel flange is damaged by hard landings or by striking obstructions, remove the casing and repair the wheel if possible. If the wheel cannot be repaired, replace with a new or serviceable wheel.

f. If it is known that tires have struck large stones or other damaging objects or have been subjected to abnormal usage in service, remove the casings as soon as possible and inspect the cord body for ruptures or breaks. Also inspect the beads for physical damage extending through the outside rubberized chafer fabric. Inspect the tread for cuts through or cuts exposing the fabric to moisture and dirt. Cuts may be filled with an approved filler.

g. When the casing is removed at any time, inspect the inner tube for the following defects:

(1) Valve for physical damage.

(2) Tube for evidence of wrinkles and creases.

(3) Tube for evidence of cuts, punctures, or thinning adjacent to the bead because of brake heat.

(4) Indications of chafing or pinching caused by casing breaks.

h. Repair all defective tubes by a permanent method if possible. If permanent repair facilities are not available, temporary repairs may be made by cold patch methods as follows:

(1) Clean the area around the hole in the tube with solvent. Thoroughly buff the area around the hole.

(2) Spread a thin layer of rubber cement over the buffed area, covering slightly more area than the size of the patch to be applied.

(3) Allow the cement to dry or set until it becomes tacky. Remove half of fabric backing from patch. Center the patch over the hole and remove remainder of the patch backing, taking care not to touch under side of patch. Roll the patch down firmly making certain that it is smooth. Check tube for additional leaks.

3. Protect the tires from oil and sunlight, as both are injurious to rubber. If oil is spilled on the tires, wipe it off immediately with a cloth dampened in clear gasoline. Install covers, if available, on the tires when working in the nacelles to protect the tires from oil spillage.

4. Main wheel rims are provided with a stripe of paint to provide a means of detecting tire slippage. Inspect the tires and wheel rims daily for alignment of the paint stripes. If the markings do not register, realign the tire and wheel rim markings before the airplane is again operated.

(d) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.

a. When remounting the tire do not use powdered soapstone or talc on the tube or in the casing. Do not use lubricant of any kind on the tire beads or wheel rim flanges.

b. Place the deflated tube in the casing. To obtain the proper balance of the wheel, casing, and tube, the mark on the inner tube which represents the heavy portion of the tube must be lined up adjacent to the casing red balance marker, which represents the lightest portion of the casing.

c. Inflate the tube sufficiently so that it is rounded out and has no wrinkles.

d. With the valve stem pointing in the proper direction to be inserted through the holes in the wheel, place the casing over the wheel. Double the valve stem into the casing behind the bead so that the stem will not catch on the wheel.

e. Work the first bead on the wheel as far as possible. Work the other bead on the wheel enough to clear the seat of the removable flange.

f. Install both halves of the removable flange. Make sure the notches on the flanges fit over the small lug on the wheel. Install the removable flange bolts, tighten the nuts solidly, back off ½ turn, and safety with lock wire.

g. Pull the valve stem through the holes in the wheel with a suitable valve stem fishing tool. Install valve stem washer and nut.

h. Without inserting the valve core, inflate the tire to 100 pounds approximately or enough to force the beads into place on the tapered bead seats. Allow the tire to deflate completely. Install the valve core and inflate the tire to the proper pressure. Tighten snugly the valve stem nut and install the valve cap.

Note

Inflate the tire by the deflection method, as described in this paragraph *b.*(7)*(c)1.*

2. INSTALLATION.—To install the wheel assembly, refer to this paragraph *b.*(6)*(b)5.*

(8) LANDING-GEAR SIGNAL SYSTEM.—The landing-gear signal system consists of a warning horn and red and green indicator lamps. The indicator lamps are located on the right side of the instrument panel. The warning horn, located on the left wall of the pilots' compartment to the left of the pilot's seat, sounds if either throttle is in the 1200 engine rpm position or below with the propeller control in high rpm and the landing gear is extended and unlatched, or when the gear is retracted, or when the landing-gear control valve handle is not in the "NEUTRAL" position. When the landing gear is latched down and the landing-gear control valve handle is in the "NEUTRAL" position, the green lamp will be lighted. If the landing gear is retracted, or the landing gear is extended and unlatched, or the landing-gear control valve handle is not in the "NEUTRAL" position, the red lamp will be lighted. For all other information about the landing-gear signal system, refer to this section, paragraph 14. *d.*(11)*(a)3.*

c. TAIL WHEEL GEAR. *(See figures 182 and 186.)*

(1) DESCRIPTION.—The tail wheel gear is full swiveling and consists of a spindle, fork, wheel and tire, and air-oil shock absorber. The tail wheel gear is de-

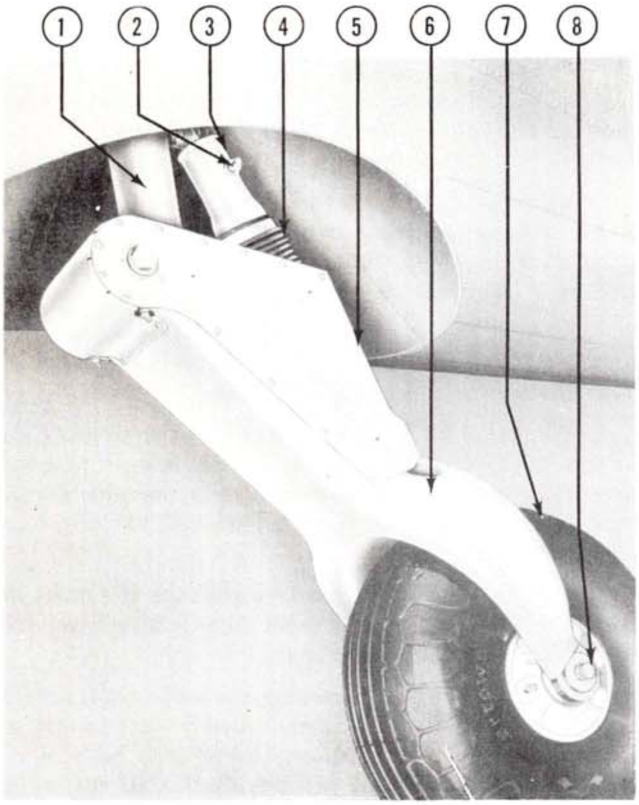


Figure 182—Tail Wheel Gear Installed

1. Tail Wheel Spindle
2. Tail Wheel Shock Strut Filler Plug
3. Tail Wheel Shock Strut
4. Dust Excluder (On Some Airplanes)
5. Tail Wheel Fork Fairing
6. Tail Wheel Fork
7. Tail Wheel and Tire Assembly
8. Tail Wheel Axle

signed so that, although capable of rotating in an arc of 360 degrees, the tail wheel remains in the trailing position when the airplane takes off or lands. The tail wheel gear may be locked in the trailing position by a lever, located on the control pedestal beneath the throttle quadrant in the pilots' compartment. The component parts of the tail wheel gear are as follows:

(a) TAIL WHEEL.—The tail wheel is a magnesium-alloy casting mounting a 22 x 9:00-6 8-ply rib-tread tire and a type I heavy-duty inner tube. The tail wheel assembly is mounted in the tail wheel fork by a straight pin axle. Bendix or Firestone wheels are installed on the tail gear.

(b) SPINDLE.—The spindle is constructed of steel tubing and is attached to the fuselage at two places. The upper end of the spindle is attached to a ball end and cap. The spindle is bolted to the fuselage near the midpoint of the spindle and turns in a ball-bearing fitting. The lower end of the spindle is bolted to the tail wheel fork and the shock absorber strut. (See figure 183.)

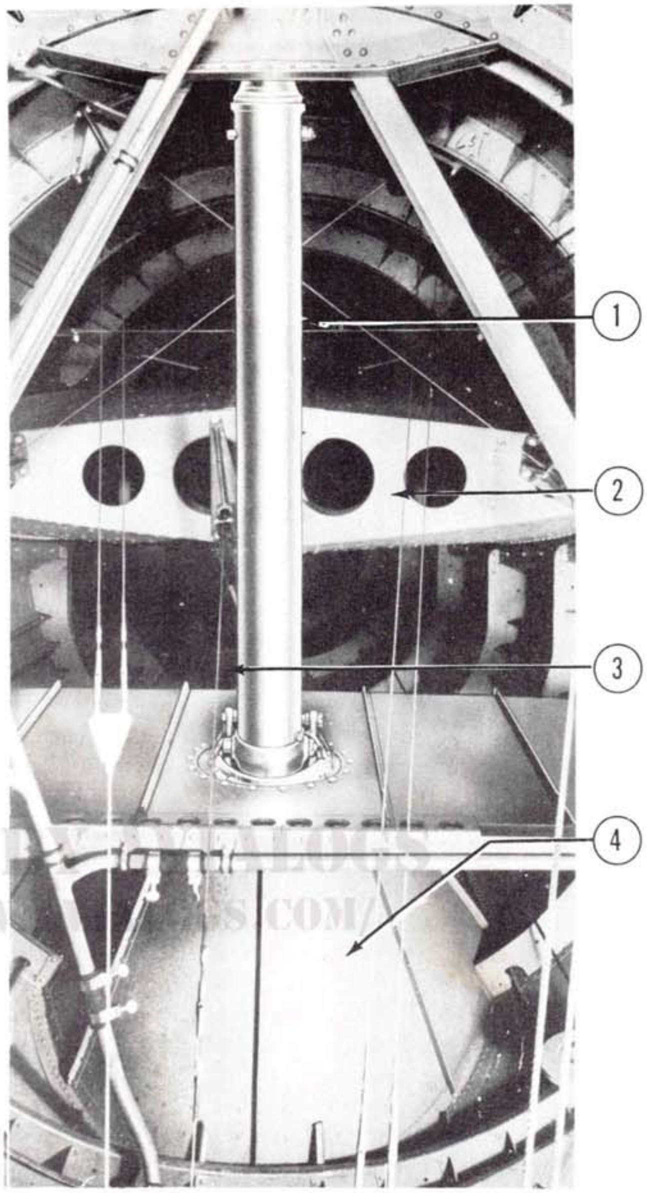


Figure 183—Looking Aft at Tail Wheel Gear Installation

1. Tail Wheel Spindle Assembly
2. Horizontal Stabilizer
3. Tail Wheel Lock Cable
4. Tail Cone Assembly

(c) TAIL WHEEL FORK.—The tail wheel fork is a casting that mounts the tail wheel and is connected to the spindle and shock absorber strut.

(d) SHOCK ABSORBER STRUT.—The air-oil shock absorber strut is attached at the upper end to a lug on the lower rear side of the spindle and at the lower end to the tail wheel fork. Impact loads on the tail wheel strut are absorbed by forcing the hydraulic fluid in the strut through a hole in the strut piston. Taxiing loads are absorbed mainly by the compression of the air in the upper chamber of the strut. For a com-

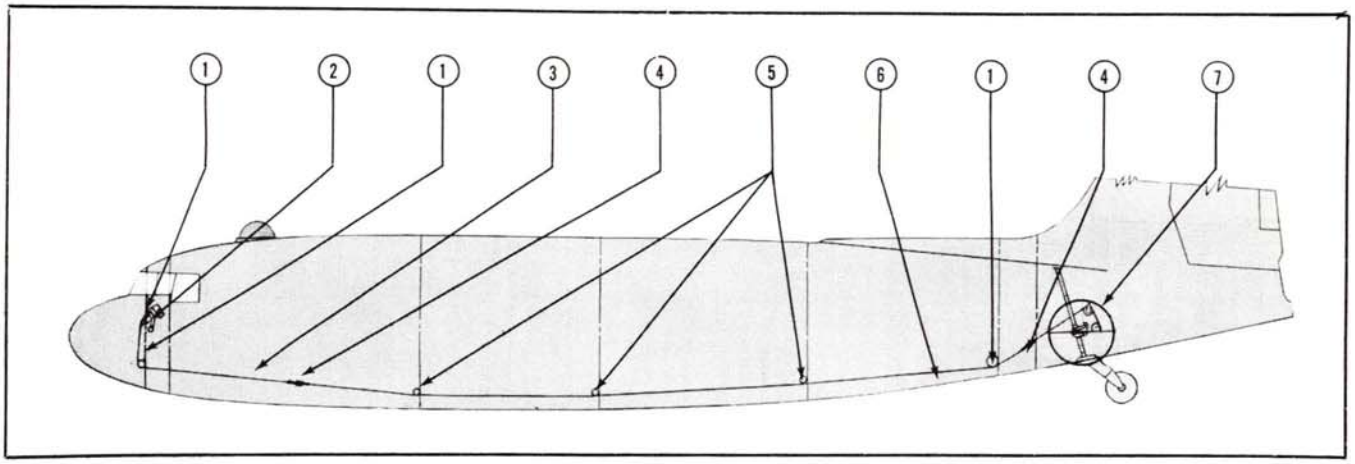


Figure 184—Tail Wheel Lock Cable System

(Douglas Dwgs. Nos. 5115220, 5115221, 5115229, and 5110547)

Item	*Part No.*	*Part Name*	*No. Req*
1	AN210-2A	Pulley	3
2	2116133	Tail Wheel Lock Lever	1
	AN4-10	Bolt	1
	AN310-4	Nut	1
	AN380-2-2	Cotter	1
3	2116168	Cable Assembly	1
4	AN155-16L	Barrel	2
5	AN210-1A	Pulley	3
6	2074407-6-7-48800	Cable Assembly	1
7		(See figure 185)	

NOTE: Refer to section IX for cable fabrication information.

plete description of the tail wheel shock absorber strut, refer to this section, paragraph 13.*c.*(6).

(e) STATIC GROUND CHAIN.—On some airplanes, a static ground chain was installed on the tail wheel axle. However, a static ground chain assembly is not necessary when static conductor type tires are installed on the airplane and the ground chain may be removed. The words "Electrical Conductor" in raised letters is located directly under the tire size identifying the tail wheel tire as an electrical conductor type tire.

CAUTION

If the tail wheel tire is not an electrical conductor type, a static ground chain must be installed.

(f) TAIL WHEEL LOCKING MECHANISM. *(Figures 184 and 185.)*—The tail wheel lock assembly is cable operated by a lever located under the throttle quadrant on the control pedestal in the pilot's compartment. The spring operated lock at the tail wheel is a key and slot mechanism with the slot mounted on the spindle and the key hinged to the fuselage structure. The key is pulled from the slot by the cable, which connects to the control handle in the pilot's compartment, and the tail wheel spindle turns freely. A spring relocks the assembly when the control handle is released. A Dural pin secures the slotted fitting to the spindle and, in the event of excessive side load on the tail wheel, the pin will shear allowing the tail wheel gear to swing free before damage to the fuselage structure occurs. The lock operates only when the tail wheel is in the trailing position, the normal position of the wheel in flight.

WARNING

When towing or turning the airplane, be sure the tail wheel is unlocked, to prevent premature shearing of the spindle shear pins.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL OF COMPLETE TAIL WHEEL ASSEMBLY.

1. Raise the tail of the airplane as instructed in section III, paragraph 2.*b.*(2) until the tail wheel is approximately four feet off the ground.

2. Disconnect the tail wheel lock cable and spring from within the fuselage aft of the lavatory compartment (figure 183).

3. Support the tail wheel assembly by a bar inserted through the hollow link pin in the fork directly below the shock absorber and tail fork attachment after removing the nut, bolt, and washers from the pin.

4. Remove the fairing from the fork.

5. Remove the nuts at the spindle center bearing and lower the tail gear out of the airplane.

(b) DISASSEMBLY.

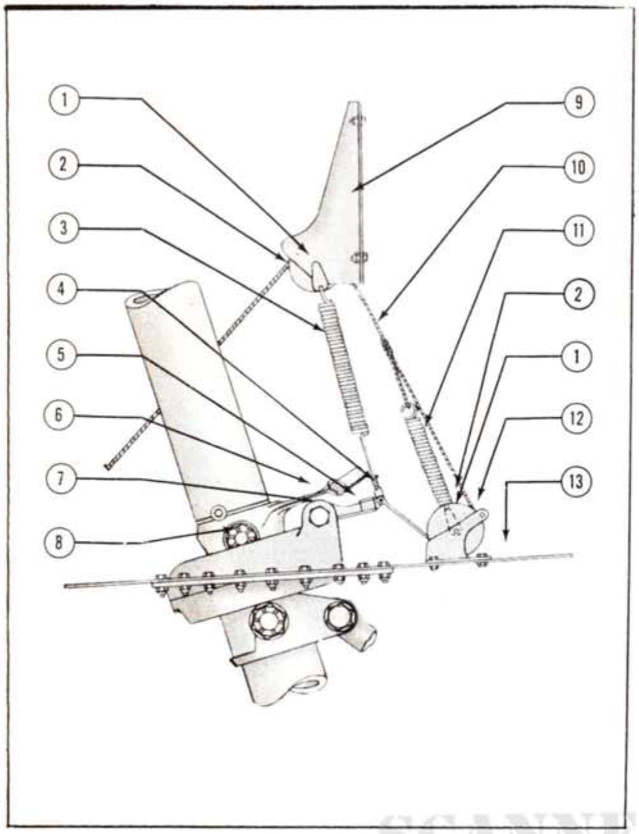


Figure 185—Tail Wheel Lock Mechanism

1. To remove the shock strut from the tail wheel gear, remove the attaching bolts.

2. To remove the fork from the spindle, remove the attaching bolt.

3. To remove the wheel and tire assembly from the fork, remove the lock nut and drive out the axle with a bar that fits over the towing lugs, as shown in figures 187 and 188.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) BUSHINGS.—Rebush tail wheel gear at each major overhaul of the airplane. Refer to tail wheel gear bushing chart at end of this paragraph for bushing information.

(b) BEARINGS.—Clean and lubricate the upper and center antifriction bearings every 200 or 300 hours as follows:

1. Remove the tail gear as instructed in this paragraph *c.*(2) and disassemble the spindle from the yoke assembly.

2. Clean the bearings with solvent, Federal Specification No. P-S-661, and blow with air to remove any foreign matter. Prevent the bearings from spinning during the blowing operation.

3. When the bearings are thoroughly clean and dry, check for roughness of the balls and races. If any roughness is found, replace the bearings.

(Douglas Dwg. Nos. 5115220, 5115221, 5115229, 5110547)

Item	*Part No.*	*Part Name*	*No. Req*
1	1115981-1	Link	2
2	AN210-2A	Pulley	2
3	1115980	Spring	1
4	1115981-2	Link	1
	1139349	Pin	1
	AN380C2-2	Cotter	1
5	2115841	Lock	1
6	4115860	Collar	1
7	111904-8-526	Bolt	1
	AN320-8	Nut	1
	AN380-3-3	Cotter	1
8	1115820	Pin	1
	AN320-9	Nut	1
	AN960-916	Washer	1
	AN380C4-4	Cotter	1
9	4118076	Bracket	1
	AN3-5A	Bolt	3
	AN320-3	Nut	1
	AN380-2-2	Cotter	3
	AN23-21	Bolt	1
	AN960-D10	Washer	4
	AF365-1032	Nut	3
	143358-030A	Pin	2
10	2118995	Cable Assembly (refer to section IX for cable fabrication information)	1
11	1115976	Spring	1
12	4118730	Bracket	1
13		Support Plate	(Ref)

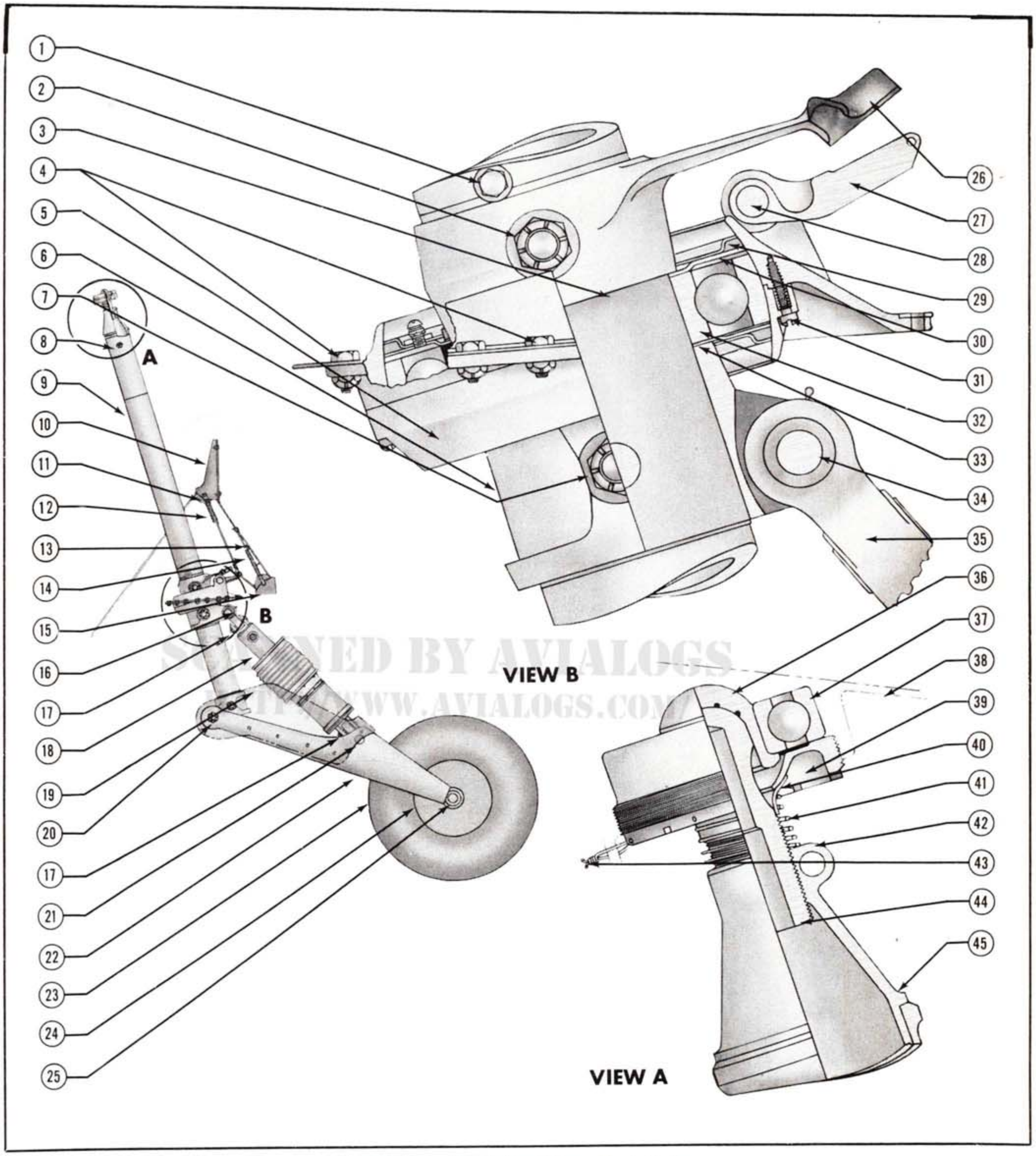

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
17
21
22
23
24
25
A
B
VIEW B
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
VIEW A

Figure 186—Tail Wheel Gear Installation

(Douglas Dwg. Nos. 5115220 and 5115221)

Item	*Part No.*	*Part Name*	*No. Req*
1	AN4-42	Bolt	1
	AN310-4	Nut	1
	AN380-2-2	Cotter	1
	143908-008D018-128	Washer	2
2	1115820	Pin	1
	AN320-9	Nut	1

KEY TO FIGURE 186—Con't

Item	*Part No.*	*Part Name*	*No. Req*
	AN960-916	Washer	1
	AN380C4-4	Cotter	1
3	143908-318R400-.010	Washer	3 (max.)
4	AN4-7A	Bolt	18
	AF365-428	Nut	18
5	5115861	Housing Assembly	1
6	4115858	Lug	1
7	AF386-8-36	Pin	2
	AN320-9	Nut	2
	975-9	Washer	2
	AN380-C4-4	Cotter	2
8	AF386-4-27	Pin	1
	AN320-5	Nut	1
	AN380-2-4	Cotter	1
	AF975-5	Washer	1
9	3115856	Spindle Assembly	1
10		Bracket (See figure 184)	(Ref)
11	1115981-1	Link	2
12	1115980	Spring	1
13	2118995	Cable Assembly	(Ref)
14	1115976	Spring	1
15		Bracket (See figure 184)	(Ref)
16	AF286-3	Grease Fitting	1
17	111904-12-223	Bolt	2
	1115802	Spacer	2
	AN320-12	Nut	2
	AN380C4-6	Cotter	2
18	5143760	Shock Strut Assembly	1
	Consists of		
	5115222	Shock Absorber Strut	1
	5143698	Dust Excluder (Some Airplanes)	1
19	5115984	Fairing	1
	Attached by		
	AN520-10-6	Screw	36
	AN935-10	Washer	12
	AF365-1032	Nut	10
	AF940-316	Washer	12
20	AN14-93	Bolt	1
	AN310-14	Nut	1
	AN380C4-5	Cotter	1
	1115803	Spacer	2
21	1115818	Screw	1
	1115806	Pin	1
	143908-008D112-.125	Washer	2
	AF286-2	Grease Fitting	1
	AN4-43	Bolt	1
	AN960-416	Washer	1
	AN310-4	Nut	1
	AN380-2-2	Cotter	1
	AF995C32-10	Lock Wire	1
22	5115862	Tail Wheel Fork	1
	1115805	Top End Bushing	4
	1115804	Center Bushing	2
	116500-20C-.020	Fork End Bushing	2
23	22 x 9:00-6	8-Ply Rib Tread Casing with Type I Heavy Duty Tube	1 ea
24	52058 or	Bendix Wheel Assembly	1
	XS0200	Firestone Wheel Assembly	1
25	1115797	Axle Assembly	1

KEY TO FIGURE 186—Con't

Item	*Part No.*	*Part Name*	*No. Req*
	AN320-20	Nut	1
	AN380-4-10	Cotter	1
	1140831	Washer	1
	2139383	Guard LH	1
	2139382	Guard RH	1
	AN526-1032-8	Screw	2
	AF936B-10	Washer	2
26	4115860	Collar	1
27	2115841	Lock	1
28	111904-8-526	Bolt	1
	AN320-8	Nut	1
	AN380-3-3	Cotter	1
29	2072177-2002A007-003	Felt	1
30	2130375	Seal Assembly	1
31	AN502-10-14	Screw	19
	AF995C32-35	Lock Wire	1
32	218WDDB	Fafnir Spherical Bearing	1
33	2115840	Seal Assembly	1
	2072177-2002A007-003		
34	111904-12-301	Bolt	1
	1115801	Spacer	1
	AN320-12	Nut	1
	AN380C4-6	Cotter	1
35	2115849 or 2203993	Link Assembly	2
	Includes		
	116500-18B-124	Bushing	1
	116500-16C-108	Bushing	1
36	1115977	Socket	1
37	308W	Fafnir Bearing	1
38	5116317	Fitting	1
39	2115982	Cap	1
40	1115978	Sleeve	1
41	1115979	Spring	1
42	AN310-6	Nut	1
	AN6-21	Bolt	1
	AN380-3-3	Cotter	1
43	AF995-C51-4	Lock Wire	1
44	1115799	Ball	1
45	2115852	End	1

4. Lubricate the wheel bearings with grease, high temperature lubricating, Specification No. AN-G-5.

5. Inspect the felt bearing retainer in the center bearing fitting and replace, if necessary.

(c) TAIL WHEEL.

1. The tail wheel bearings are to be removed, inspected, and lubricated as often as necessary to insure proper functioning. At every 100/120-hour inspection, the bearings should be lubricated as indicated in figure 84.

a. Remove the grease retaining cup and parts and remove the bearings. Clean the bearings in solvent, Federal Specification No. P-S-661, to completely dissolve the grease. Move the bearing vigorously through the solvent to remove any particles of foreign matter. Allow bearing to dry.

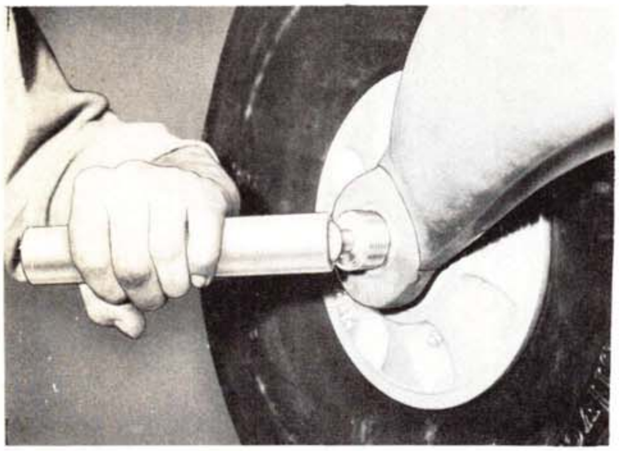


Figure 187—Installing Bar on Tail Wheel Axle

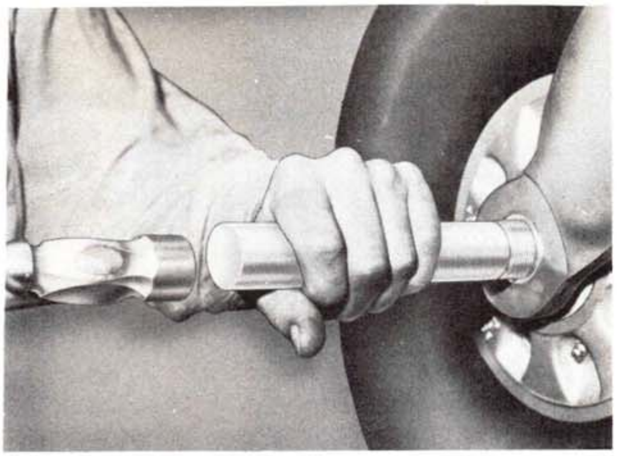


Figure 188—Removing Tail Wheel Axle

b. When the bearing has been cleaned thoroughly and is dried completely, inspect the bearing for roughness. Replace unserviceable bearings.

c. Lubricate the serviceable bearings with grease, high temperature lubricating, Specification No. **MIL-L-3545.**

d. Excessive use of grease should be avoided but the grease should be worked carefully into the rollers of the bearings. Make certain the felt retaining washers are in good condition so that the grease will not work out from the hub and to prevent dirt from entering the bearings.

2. Replace the bearing cups if they are cracked or loose. The bearing cups are removed by either heating the wheel or cooling the bearing sufficiently to permit easy movement of the bearing. A temperature differential of approximately 38°C (100°F) between the wheel and the bearing is necessary. Never force the bearing either in or out of the wheel by hammering or pressure.

3. Portions of the wheel, where the original finish has peeled or been chipped, are retouched by using aluminum-pigmented lacquer, Specification No. AN-TT-L-51. Use one or two coats, depending on the condition of the original paint. If it is necessary to refinish the entire surface, apply one coat of primer, **Specification No. MIL-P-6889a, and two coats of lacquer, Specification No. AN-TT-L-51. Clean the surface** thoroughly before applying the primer. Remove the original finish with acetone, Federal Specification No. **O-A-51b.**

4. Except for replacement of the bearing cups or bearing assemblies, and refinishing of the wheel, no repair can be made to the wheel. If the wheel is distorted excessively or cracks appear in the casting, replace the wheel with a new part.

(d) TIRE AND TUBE.

1. Remove the wheel and tire assembly from the axle. Deflate the tail wheel tire completely by removing valve core. To disassemble the tail wheel, remove the fairing (on some wheels) and remove the cotters that lock the nuts on the bolts. Remove the through bolts and separate the halves of the tail wheel. Remove the tire and tube by slipping them off the wheel halves.

2. For repair instructions for the tail wheel tire and tube, refer to this paragraph *b.*(7)*(c).*

3. Inflate the tail wheel tire by the deflection method as described in this paragraph *b.*(7)*(c).*

(e) SHOCK ABSORBER STRUT.—Refer to this section, paragraph 13.*c.*(6)*(c)* for maintenance procedure for the tail wheel shock strut.

(f) SPINDLE AND FORK.—Inspect the spindle, fork, fairing, bolts, axle, and locking pins for wear or damage. Replace with new parts as necessary. Check the tail wheel locking mechanism for damaged parts and replace, if necessary.

(4) ADJUSTMENTS.

(a) TAIL WHEEL BEARING.—After the tail wheel is installed, make a careful adjustment of the tail wheel bearing. Use an axle nut wrench and tighten the axle nut until a bearing drag is evident when spinning the tail wheel by hand. Back off the axle nut to the next castellation and secure with a cotter. The tail wheel

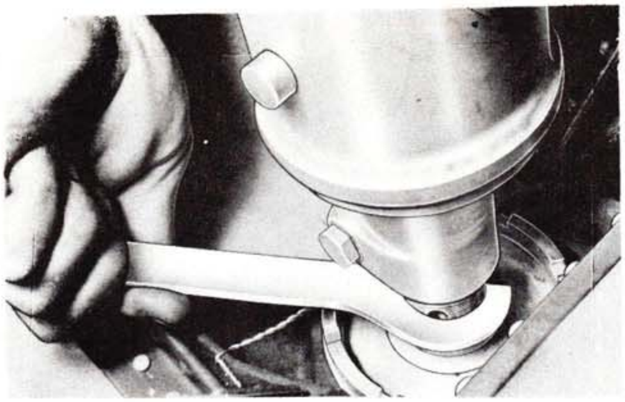


Figure 189—Use of Tail Wheel Spindle Ball End Spanner Wrench (Service Tool No. K20801)

should revolve freely after this adjustment without a bearing drag. Check tail wheel for side play after making this adjustment.

(b) TAIL WHEEL LOCK MECHANISM *(figure 184)*.—Adjust the tail wheel lock mechanism as follows:

1. Place the control handle on the control pedestal in the "LOCK" position. Even the cable forward turnbuckle to barely bury the threads and safety with lock wire.

2. Adjust the cable aft turnbuckle to give minimum amount of slack aft of splice to insure good bottom on lock.

3. Place the control handle in the "UNLOCK" position and check for 1/8-inch minimum clearance between the lock and the mating part on the tail wheel spindle, and 1/32-inch minimum clearance between the aft end of the cable and the pulley. Safety the cable aft turnbuckle after the cable is properly adjusted.

(c) SPINDLE BALL AND SOCKET.—When the tail gear is installed, it is necessary to adjust the spindle ball end and socket for preload adjustment. With the tail wheel clear of the ground, turn the ball in the socket until snug, then add one full turn for preload adjustment. Use service tool (K20801) as shown in figure 189. To adjust the spindle cap use service tool (K20901) as shown in figure 190. These tools may be fabricated according to figures 87 and 88.

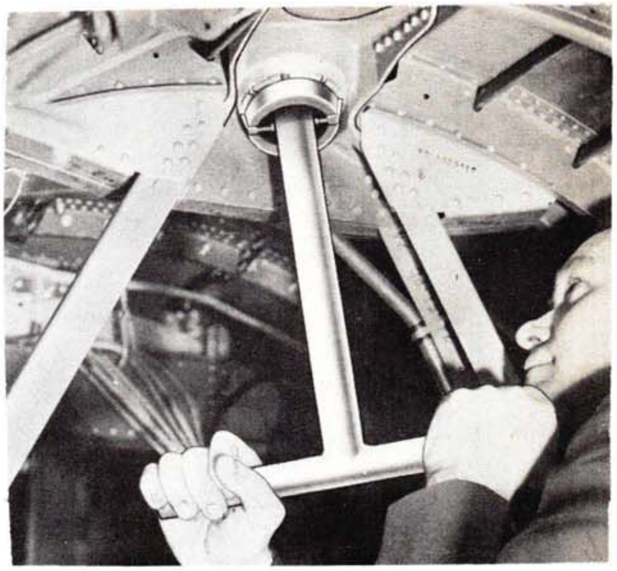


Figure 190—Use of Tail Wheel Spindle Cap Wrench (Service Tool No. K20901)

(5) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.—Refer to figure 186 to assemble the tail wheel gear.

(b) INSTALLATION.

1. The tail of the airplane must be raised sufficiently to allow installation of the tail wheel gear. Refer to section III, paragraph 2.*b.(2)*.

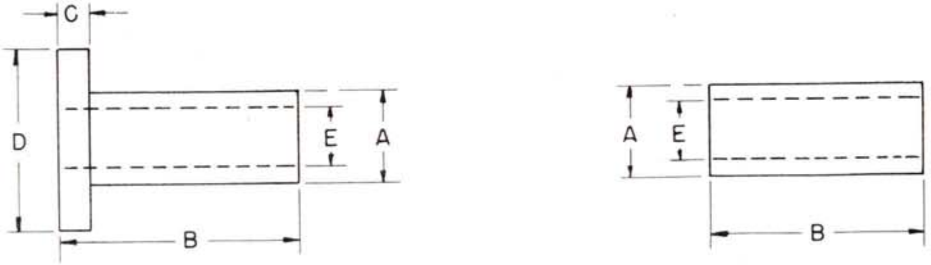
2. Install the socket in the upper bearing and pack the bearing with grease, high temperature lubricating, Specification No. AN-G-5.

3. Place the bearing and socket in the casting and screw cap into casting. (See figure 190.) Safety the cap with lock wire.

4. Lift the tail gear assembly in place in the airplane. Place the spring and sleeve over the ball end of the spindle. Bolt the tail gear in place as shown in figure 186.

5. Turn the spindle ball end in the socket until snug, then add one full turn for preload adjustment.

6. Adjust the tail wheel locking mechanism, as instructed in this paragraph *c.*(4)*(b)*.



TYPE 1

TYPE 2

Figure 190A—Main Landing Gear and Tail Wheel Gear Bushing Chart

MAIN LANDING GEAR BUSHING CHART

Location Key	*Bushing No.*	*Next Assembly*	*No. Req*	*Type No.*	*Dimension "A"*	*Dimension "B"*	*Dimension "C"*	*Dimension "D"*	*Dimension "E"*	*Notes*	*Material*
Upper Truss-Connections to Shock Strut	1130534	5113697	4	2	1.127 to 1.126 Break edges both ends	2.298 to 2.293			.839 to .843	Ream 1.125 ±.0005 Press in bushing Drill No. 16 (.177-inch dia) through bushing from hole in boss. Line ream to .875 ±.0005	1-3/16 dia Tobin Bronze Bar Fed. QQB-636 Navy-46-B-6
Shock Strut Compensating Arm Upper End	1116411	5110589 and 5110589-1	8	1	.874 to .873	.500	.115 to .120	1.1875	.625 ±.0005		1-3/16 dia Nickel Steel Bar AF57-107-17 Navy 46-S-21
Shock Strut Compensating Arm Upper End	1116708	2116697	8	2	1.002 to 1.001	.365 to .360			.8750 ±.0005 countersink 90° x .906 dia both sides	Ream 1.0000 ±.0005. Press in bushing and ream to .8750 ±.0005 after drilling No. 50 (.070-inch) through bushing for grease fitting	1-1/8 OD x .187 C.M. Steel Tube—Cad. Plate A.C. 57-180-2 Navy 44-T-18
Shock Strut Compensating Arm Lower End	1116707	2116697	8	2	.627 to .626	.490 to .485			.5000±.0005	Ream .625±.0005 Press in bushing and ream .5000 ±.0005 after drilling No. 50 (.070-inch) hole into bushing for grease fitting	11/16 dia C.M. Steel Bar—Cad. Plate AF57-107-19 Navy 46-S-23 grade A
Landing-Gear Compensating Link	1116408	4116413 and 4116413-1	16	1	1.127±.0005 chamfer .010 x 45°	.5625	.094 ±.000 .005	1.375	.875±.0005 countersink at flange 45° x 1/32	Ream 1.125±.0005 Press in bushing and ream to .8750 ±.0005	1-7/16 OD x 13/16 ID Cent. Cast Alum. Bronze Fed.QQ-B-671 Class B (Army-Navy)
Leg Assembly Rear Brace Strut	1119001	5112598	8	1	.9395 to .9383 chamfer .031 x 45°	1.00	.0625 ±.002	1.125	.734	Ream .9375±.005 Press in bushing and line ream to .750±.0005	Amberloy No. 917 Alum. Bronze 1-1/8 dia Rod. Purchase from American Brass Co., Los Angeles,Calif.
Landing-Gear Balancer Toggle	116500-7 C-018G	4116969	2	2	.5635±.001 .000 Break edges both ends	.5625			.4375±.0005 groove inside 1/8 wide x 1/64 deep in center	Ream .5625±.0005 Press in bushing and ream .4375 ±.005. Drill 3/32-inch dia through bushing from grease fitting hole	C.R. Nickel Steel—Cad. Plate AF-57-107-17 Navy 47-S-21

MAIN LANDING GEAR BUSHING CHART—Cont'd

Location Key	*Bushing No.*	*Next Assembly*	*No. Req*	*Type No.*	*Dimension "A"*	*Dimension "B"*	*Dimension "C"*	*Dimension "D"*	*Dimension "E"*	*Notes*	*Material*
Landing-Gear Balancer Toggle	116500-6C-021	4116969	4	2	$.501 \pm {}^{.001}_{.000}$ Break edges both ends	.6562			.375 ± .0005	Line Ream .5000 ± .0005. Press in bushing and line ream .375 ± .0005	C.R. Nickel Steel—Cad. Plate AF57-107-17 Navy 47-S-21
Compensator Cylinder End Cap	22-2245 Smith Meter Co.	22-2231 Smith Meter Co.	2	1	$.501 \pm {}^{.001}_{.000}$ Break corners .015 ± .005	.437 ± .010	.093 ± .005	.875	.3593	Ream .500 ± .0005 Press in bushing and line ream to $.375 \pm {}^{.001}_{.000}$	Brass Bar—1/2 hard Fed. QQ-B-636
Mechanical Latch Pulley Assembly Spacer	1117046	5110570	2	2	.248 to .245	.285 to .280			.193 to .200		5/16 dia Nickel Steel—Cad. Plate AF-57-107-17 Navy 46-S-21
Bearing for Mechanical Latch Torque Tube	1117042-2 Make from Oilite Bushing No. A-838-4 or equiv.	5110570	2	2	.878	1.50			.751	Ream .875 ± .0005 Press in bushing and burnish to .750 ± .0005	Oilite. Purchase from Amplex Div of Chrysler Corp., Detroit, Michigan. One A-834-4 bushing makes two 1117042-2 bushings
Mechanical Latch Pulley Assembly	A-304 Std Oilite Bushing	2117378	2	2	.377	.4062			.2505	Ream .3755 to .3745 Press in bushing and spotface flush with face of pulley on both sides	Oilite. Purchase from Amplex Div of Chrysler Corp., Detroit, Michigan
Mechanical Latch Arm Assembly	116500-5C-008	1117049	2	2	$.4385 \pm {}^{.001}_{.000}$ Break edges both ends	.250			.3125 ± .0005	Ream .438 to .437 Press in and ream drill to .316	C.R. Nickel Steel—Cad. Plate AF57-107-17 Navy 46-S-21
Mechanical Latch Connecting Rod Eyebolt	1117080-2 Make from Oilite Bushing No. A-304-2	1117030	1	2	.377	.426 to .421			.2505	Ream .375 ± .0005 Press in bushing and spotface flush with bolt faces. Burnish to .250 ± .0005	Oilite. Purchase from Amplex Div of Chrysler Corp., Detroit, Michigan
Rear Brace Strut Connection of Legs to Column	1113285	5112599	4	1	.874 ± .005 Break edge .031	.8437	.093	1.375	.531	Line ream .875 ± .0005 Install bushings	1-3/8 dia C.M. Steel Bar—Cad. Plate AF57-107-19 Navy 46-S-23 Grade A

MAIN LANDING GEAR BUSHING CHART—Cont'd

Location Key	*Bushing No.*	*Next Assembly*	*No. Req*	*Type No.*	*Dimension "A"*	*Dimension "B"*	*Dimension "C"*	*Dimension "D"*	*Dimension "E"*	*Notes*	*Material*
Upper Truss Wing Spar Attaching Fitting	1117830	5117828	8	1	1.190 to 1.189 chamfer 45° x 1/32	.750	.3125	1.50	.9320 to .9300-grind countersink 90° x 1-1/8 dia on flange side countersink 90° x 1 dia on opposite side	Ream 1.1875 ±.0005. Press in bushing and line ream to .9385 to .9370	1-1/2 dia Nickel Steel Bar AF57-107-17 Navy 46-S-21
Cam Assembly Landing-Gear Valve Catch	A-304 Std Oilite Bushing	2133383	1	2	.377	.4062			.2505	Ream .375±.0005 Press in bushing and burnish to .250±.0005	Oilite. Purchase from Amplex Div of Chrysler Corp., Detroit, Michigan
Cam Assembly Landing-Gear Valve Catch	A-524 Oilite Bushing	2133383	1	2	.504	.5625			.376	Ream .500±.0005 Press in bushing and burnish .375 ±.0005	Oilite. Purchase from Amplex Div of Chrysler Corp., Detroit, Michigan
Bungee Rear Yoke Shackle	131736-7C-101	5110568	4	2	.5635±.001 .000 Break edges both ends	1.0312-.010 .015			.4375 to .4415		C.R. Nickel Steel—Cad. Plate AF57-107-17 Navy 46-S-21
Landing-Gear Actuating Cylinder—Nacelle Attaching Fitting	116500-9C-124	4116529	2	2	.751±.001 .000 Break edges both ends	1.750-.010 .015			.5625±.0005	Ream .750±.0005 Press in bushing and ream to .5625 ±.0005	C.R. Nickel Steel—Cad. Plate AF57-107-17 Navy 47-S-21
Rear Brace Strut—Aft Attaching Fitting	116500-12C-108	2203937	2	2	.9385±.001 .000 Break edges both ends	1.250-.010 .015			.750±.0005	Ream .9375±.0005 Press in bushing and ream to .750±.0005 Drill 3/32 (.093-inch) through bushing for grease fitting	C.R. Nickel Steel—Cad. Plate AF57-107-17 Navy 47-S-21
Rear Brace Strut—Aft Attaching Fitting	116500-10C-108	2116632	2	2	.8135±.001 .000 Break edges both ends	1.250-.010 .015			.625±.0005	Ream .8125±.0005 Press in bushing and ream to .625±.0005 Drill 3/32 (.093-inch) through bushing for grease fitting	C.R. Nickel Steel—Cad. Plate AF57-107-17 Navy 47-S-21

MAIN LANDING GEAR BUSHING CHART—Cont'd

Location Key	*Bushing No.*	*Next Assembly*	*No. Req*	*Type No.*	*Dimension "A"*	*Dimension "B"*	*Dimension "C"*	*Dimension "D"*	*Dimension "E"*	*Notes*	*Material*
Hydraulic Compensator Adaptor	1204010	4204011	2	2	.626±.001 .000 Chamfer 45° x 1/32	.5312±.0312 .000			.359	Ream .625±.0005 and 9/16 deep both ends. Press in bushing and line ream .375±.0005	11/16 dia x 5/8 C.M. Bar Steel Army-Navy ANQQS-684

TAIL WHEEL GEAR BUSHING CHART

Location Key	*Bushing No.*	*Next Assembly*	*No. Req*	*Type No.*	*Dimension "A"*	*Dimension "B"*	*Dimension "C"*	*Dimension "D"*	*Dimension "E"*	*Notes*	*Material*
Tail Wheel Fork Upper End	1115805	5115862	4	1	1.50±1.001 .000 Chamfer 45°x 1/32	.4687	.125 to .122	1.625	1.2500±.005	Line ream 1.5000 ±.0005. Press in bushing and line ream to 1.2500 ±.0005	1-1/4 dia OD x 1 ID Cored Cast Mang. Bronze Fed. QQB-726 Navy 49-B-3
Tail Wheel Fork—Fork End	116500-20C-020	5115862	2	2	1.501±.001 Break edges both ends	.625			1.2500± .0005	Line ream 1.500± .0005. Press in bushing and locate in center of boss within 1/16 and line ream to 1.250± .0005	C.R. Nickel Steel AF57-107-17 Navy 47-S-21 Cad. Plate
Tail Wheel Fork—Center Bushing	1115804	5115862	2	1	1.376±.001 .000 Chamfer 45° x 1/32	.875	.156 to .151	1.50	1.1250± .0005	Line ream 1.375± .0005. Press in bushing and line ream to 1.125±.0005. Drill No. 3 (.213-inch) through one side of bushing. Locate from hole in casting	1-1/2 dia C.M. Bar Steel—AF57-107-19 Navy 46-S-23 Grade A
Shock Absorber Strut—Link Assembly	116500-18B-124	2115849 or 2203993	1	2	1.376±.001 .000 Break edges both ends	1.750			1.1250± .0005	Ream 1.375±.0005. Press in bushing and ream to 1.125± .0005. Drill 21/64 through bushing. Locate hole by boss in link	Tobin Bronze—Hard Fed. QQ-B-636 Navy 46-B-6 Cad. Plate
Shock Absorber Strut—Link Assembly	116500-16C-108	2115849 or 2203993	1	2	1.251±.001 .000 Break edges both ends	1.250			1.000± .0005	Ream 1.250±.0005. Press in bushing and ream to 1.000± .0005	C.R. Nickel Steel AF57-107-17 Navy 47-S-21 Cad. Plate

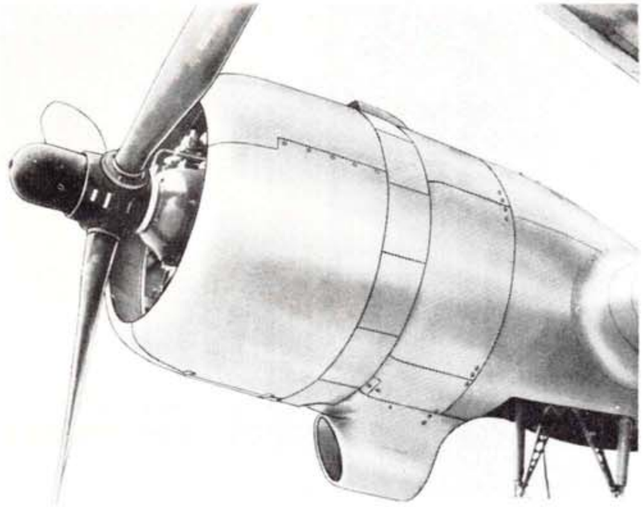


Figure 191—Engine Cowling Installed (Inboard)

5. ENGINE SECTION OF NACELLE

a. GENERAL.—The engine section of the nacelle includes the engine mount and all cowling forward of the fire wall. All accessory cowling assemblies consist of individually removable panels. Engine cowling is made up of three sections with cowl flaps attached to the aft edges. No cowling is interchangeable between left and right nacelles.

b. ENGINE MOUNT. *(See figure 193.)*

(1) DESCRIPTION.—The forged type engine mount is a detachable, chrome-molybdenum steel structure, with eight support tubes extending aft. On some airplanes a welded type engine mount, which is interchangeable with the forged type mount, is substituted for the forged type engine mount. There are eight support tubes extending aft. The engine is bolted to the mount at eight points through rubber shock absorbers. Lugs on the end of the mount support tubes are aligned with lugs on the fire wall and bolted together. The engine mount attaching bolts are torqued to a snug fit and safetied. See figure 653 for other recommended torque values.

(2) MAINTENANCE REPAIR AND REPLACEMENT.

(a) Inspect the rubber shock absorbers for failure of the rubber bond or for excessive disintegration of the rubber from contact with gasoline or oil. Replace as necessary.

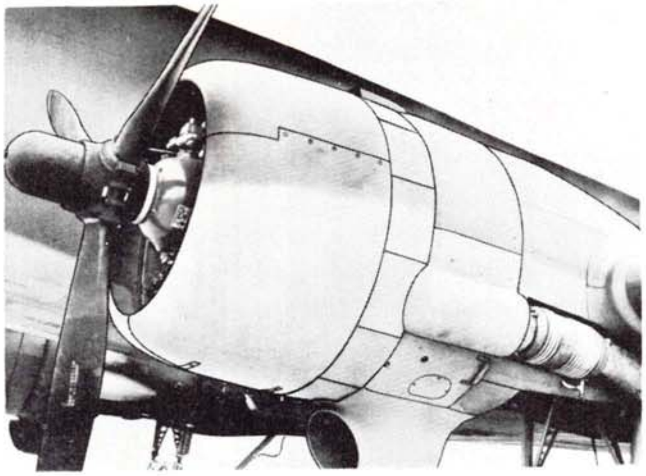


Figure 192—Engine Cowling Installed (Outboard)

(b) Minor repairs on the mount may be made by welding. All new or repaired parts must be cadmium-plated before the mount is installed. (See T. O. No. 01-40NC-3, figures 59 and 60.)

(3) TEST BEFORE INSTALLATION.—Refer to T. O. No. 01-40NC-3, section XI, paragraph 5.

(4) ASSEMBLY AND INSTALLATION.

(a) Install the mount to the engine at the eight attach points.

(b) Hoist the engine and mount into position and insert the bolts through the lugs. (See figure 202.)

c. ENGINE ACCESSORY COWLING.

(1) DESCRIPTION.—The engine accessory cowling is made up of seven panels attached by Dzus fasteners. None of the panels are interchangeable between left and right nacelles. Each part of the cowling may be removed individually by releasing the Dzus fasteners.

d. ENGINE COWLING.

(1) DESCRIPTION.—The engine cowling assembly consists of an upper and two lower sections (figure 194). The two lower sections are connected by adjustable latches and attached to the upper section by Dzus fastners and latches (figure 195) at the leading edge.

KEY TO FIGURE 193

Item	*Part No.*	*Part Name*	*No. Req. Per Assembly*
1	1116115	Bolt	2
2	4114540-1	Fitting	1
	Consists of: (typical for all tube to fitting attachments)		
	2076907-20	Bolt	10
	1075888-7A	Washer	10
3	2115030-4	Tube Assembly	1
4	2115030-5	Tube Assembly	1
5	SK1292-1	Rubber Sandwich	8
	1118876	Bushing	8
6	5115027	Engine Mount Ring, Upper Halt	1
7	2076907-15	Bolt	2
	1075888-7A	Washer	4
	12B070	Elastic Stop Nut	2

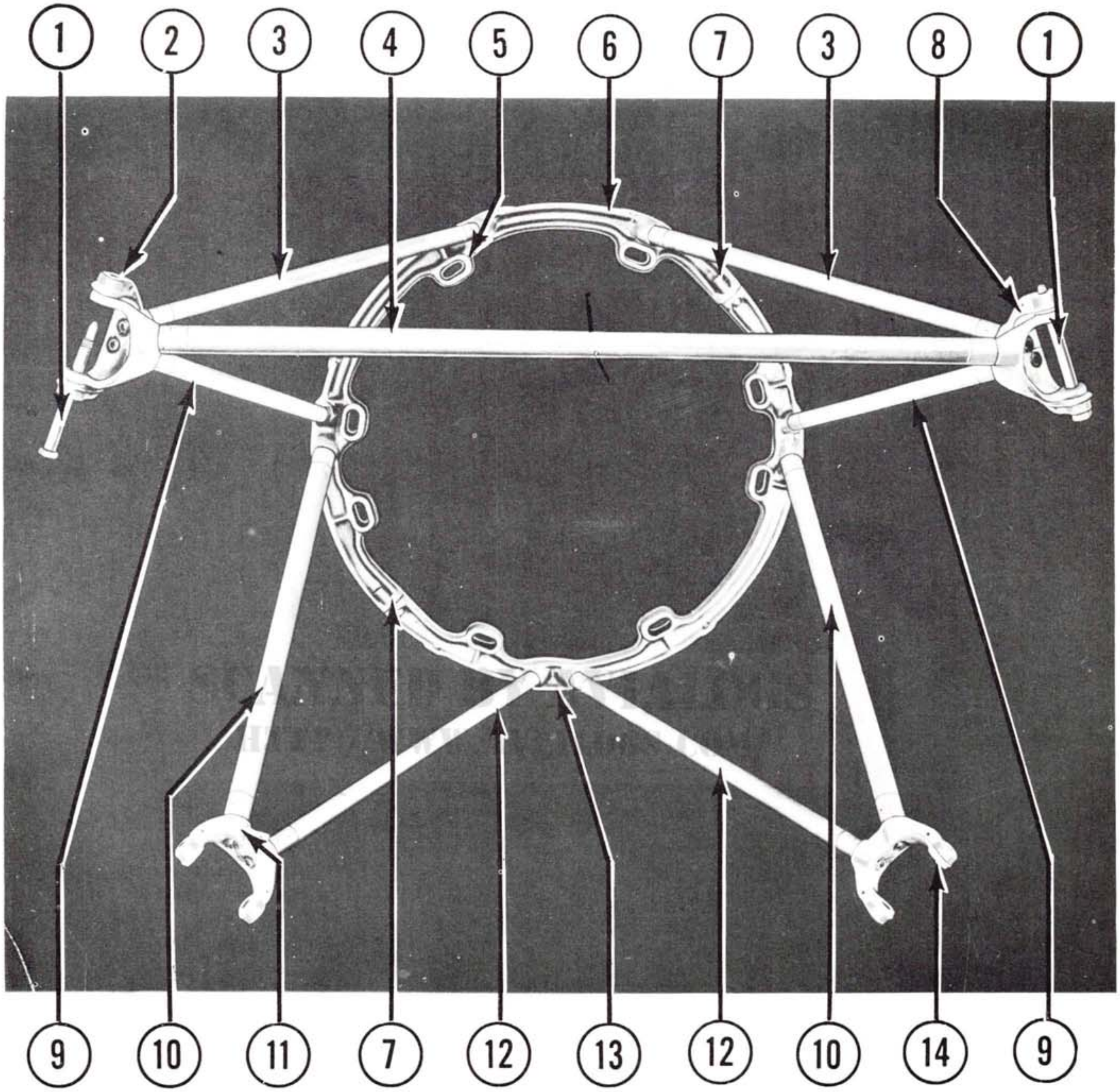


Figure 193—Engine Mount

KEY TO 193—Con't

Item	Part No.	Part Name	No. Req Per Assembly
8	4114540	Fitting	1
	2114539	Fitting	2
9	2115030-3	Tube Assembly	2
10	2115030-2	Tube Assembly	2
	1117458-2	Washer	3
11	4114541-1	Fitting	1
12	2115030-1	Tube Assembly	1
13	5115028	Engine Mount Ring, Lower Halt	1
14	4114541	Fitting	1

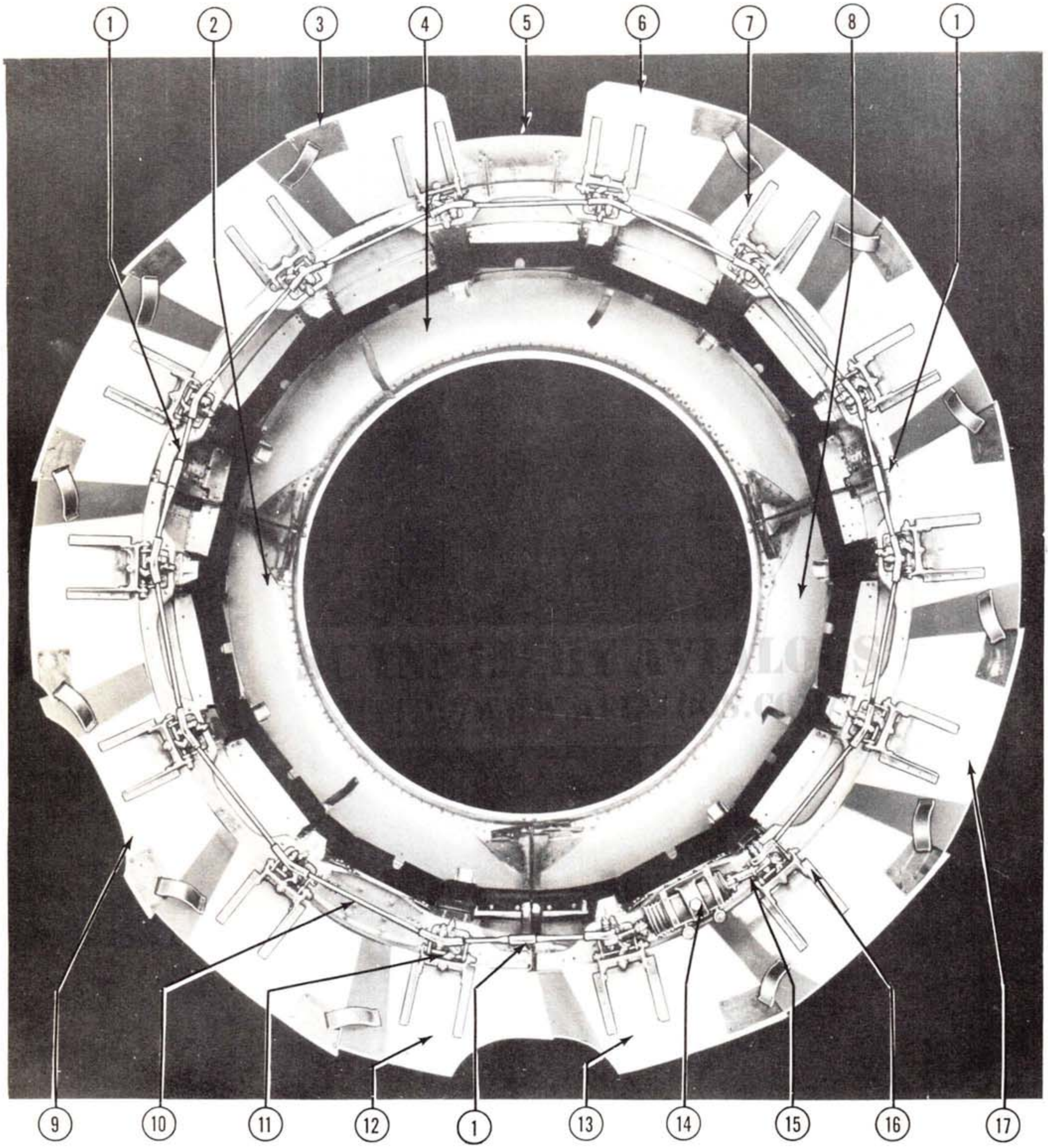

1
2
3
4
5
6
7
8
1
9
10
11
12
1
13
14
15
16
17

Figure 194—Engine Cowling and Cowl Flaps

Item	*Part No.*	*Part Name*	*No. Req Per Assembly*
1	1119089	Coupling Assembly (See figure 196, view C.)	3
2	5116638 (LH)	Segment Assembly	1
	5116638-1 (RH)	Segment Assembly	1
3	4139222	Flap Assembly	1
4	5116637	Segment Assembly	1
5	2119113	Flap Assembly	1

KEY TO FIGURE 194—Con't

Item	*Part No.*	*Part Name*	*No. Req Per Assembly*
6	4139222-1	Flap Assembly	1
7	4140827	Flap Assembly	1
8	5116639 (LH)	Segment Assembly	1
	5116639-1 (RH)	Segment Assembly	1
9	5116872-1 (LH)	Bottom Flap	1
	5116872-4 (RH)	Bottom Flap	1
10	1119087	Tie Rod	10
	AN316-4L	Check Nut	10
	AN316-4R	Check Nut	10
11	Cowl Flap Actuating Linkage (See figure 196, view A, for parts list, figure 197, view A, for bushing data)		
12	5116872-10	Flap Assembly	1
13	5116872-2 (LH)	Bottom Flap	1
	5116872-11 (RH)	Bottom Flap	1
14	2116312	Cowl Flap Actuating Cylinder	1
	4119239	Support	1
	1119084	Screw	2
	1119085	Nut	2
	AN3-6	Bolt	4
	AN310-3	Nut	2
15	1117217	Fork End	2
	AN3-10	Bolt	2
	AN310-3	Nut	2
16	Cowl Flap Actuating Linkage (See figure 196, view B for parts list, figure 197, view B for bushing data.)		
17	5116872-1 (LH)	Flap Assembly	5 (C-47) 6 (C-47A)
	5116872 (RH)	Flap Assembly	6 (C-47) 7 (C-47A)

The cowling rests on the engine rocker boxes and is supported by lugs bolted to every other rocker box of both banks of engine cylinders. Cowl flaps are attached to the aft edges of the three sections. See paragraph 5.*e.* following.

(2) REMOVAL AND DISASSEMBLY.

(a) Open the cowl flaps fully.

(b) Cut the safety wires and disconnect the electrical bonding strips.

(c) Disconnect the cowl flap tie rods at the three joints located at each segment connecting point.

(d) Disconnect the hydraulic hoses from the actuating cylinder and plug the lines.

(e) Remove the safety screws from the trunnion fastener at the bottom of the ring.

(f) Unlatch the three cowling segment connecting latches.

(g) Unfasten Dzus fasteners on the sides of the cowling.

e. COWL FLAPS.

(1) DESCRIPTION.—Hydraulically operated cowl flaps (figure 194) are attached to the aft edge of the engine cowling. On airplanes with the nonram air induction system, the center flap of the top segment is stationary. On airplanes with a filtered ram-type air induction, the three flaps in the center of the top segment are fixed. A hydraulic actuating cylinder (14, figure 194) is installed on the lower part of the engine cowling. This cylinder is connected to each movable cowl flap by a series of tie rods and operating levers. Movement of the cylinder, and thus actuation of the flaps, is controlled by left and right engine cowl flap control valves located on the right side of the pilot's compartment. These valves may place the flaps in the "CLOSED," "OPEN," or "TRAIL" position, or lock them in any position.

(2) REMOVAL AND DISASSEMBLY.

(a) Remove the engine cowling segments as described in paragraph 5.*d.*(2), this section.

(b) Remove the nuts from the bolts on the flap base bracket on the engine cowling rear channel.

(c) Remove the axle or hinge bolt and remove the flap.

(d) The center flap of the top segment is not removable.

(3) MAINTENANCE REPAIR OR
REPLACEMENT.

(a) For maintenance information on the hy-

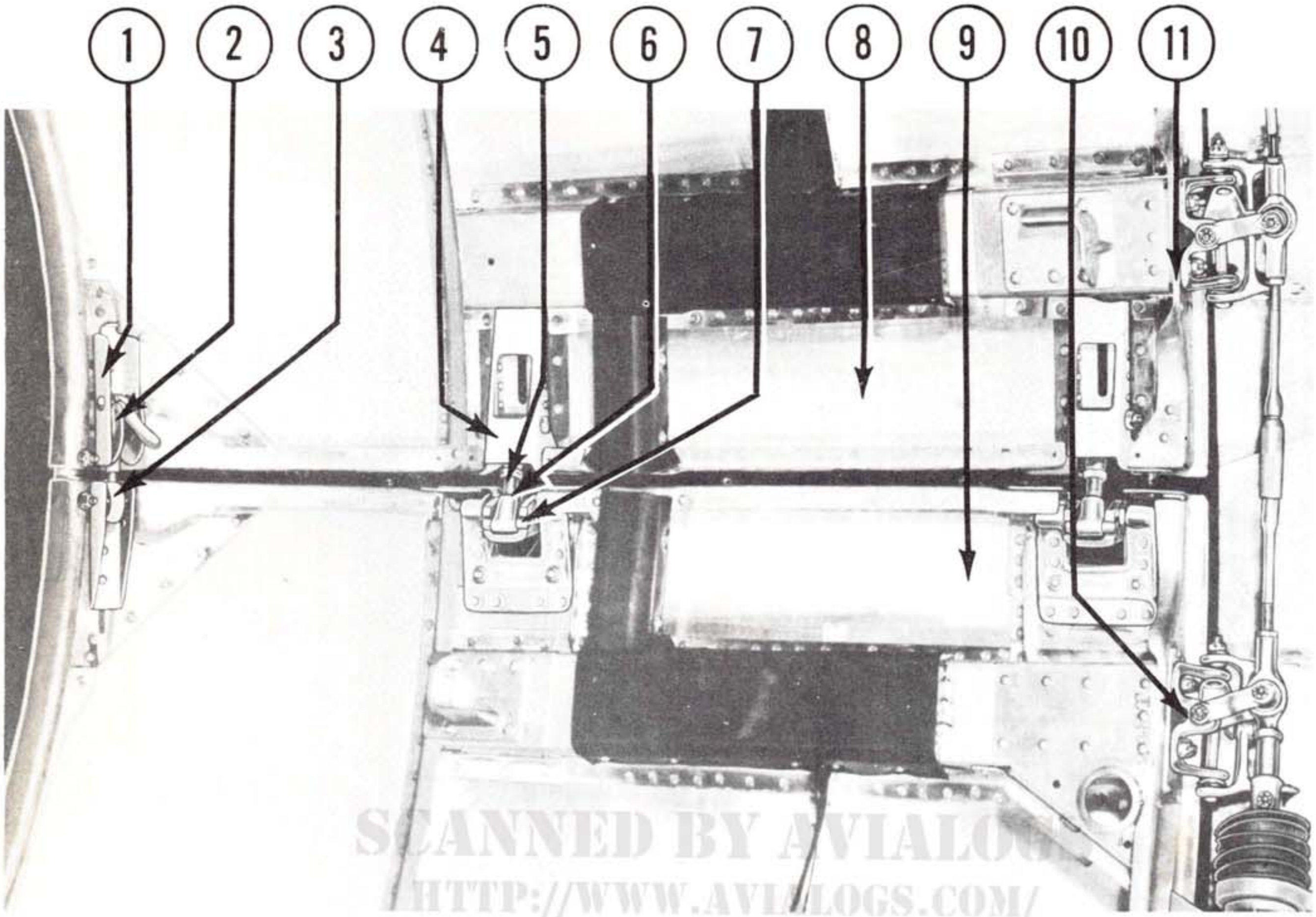


Figure 195—Toggle Latch Installed

Item	*Part No.*	*Part Name*	*No. Req Per Assembly*
1	2114845	Bracket	1
2	2114844	Link	1
	AN3-12	Bolt	1
	115128	Spacer	1
	1117632	Pin	1
3	2115035	Toggle	1
4	4118145	Bracket	1
5	AN4-16	Bolt	1
	AN310-4	Nut	1
6	2119948	Link	2
	AN316-6R	Nut	2
7	1117628	Hook	1
	1117634	Eye	2
8	5116638 (LH)	Segment Assembly	1
	5116638-1 (RH)	Segment Assembly	1
9	5116639 (LH)	Segment Assembly	1
	5116639-1 (RH)	Segment Assembly	1
10	Cowl Flap Actuating Linkage (See figure 196, view B.)		
11	Cowl Flap Actuating Linkage (See figure 196, view A.)		

KEY TO FIGURE 196

Item	*Part No.*	*Part Name*	*No. Req Per Assembly*
1	AN3-36	Bolt	
2	2114314	Support	14
3	2114317	Lever	10

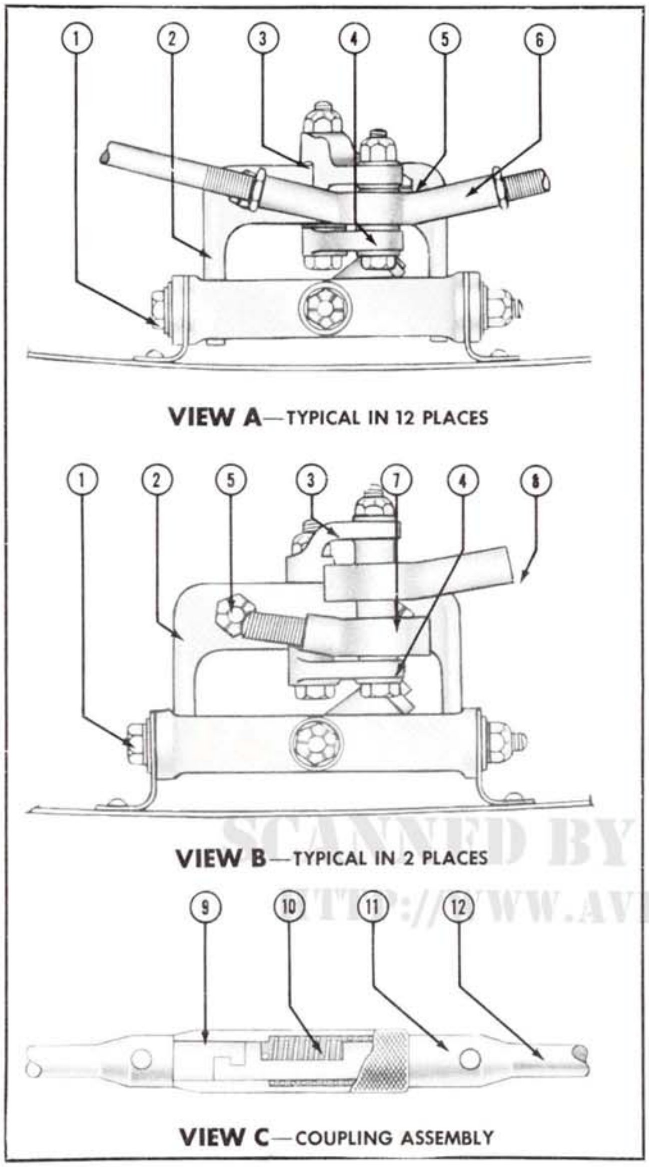


Figure 196—Cowl Flap Linkage Details

draulic actuating cylinders or flap control valves, refer to paragraph 13, this section.

(b) for bushing information, refer to the cowl flap bushing chart (figure 197).

(c) Be sure that the leather flaps on the inside of the engine cowling ring are forward of the diaphragm.

(4) ADJUSTMENT.

(a) When in the "CLOSED" position, the cowl flaps should follow the contour of the engine cowling.

(b) If adjustment is necessary to bring any one flap to this position, loosen the jam nuts at both ends of the connecting rods on either side of the flap brackets and shorten or lengthen the rods equally as necessary (10, figure 194).

(c) Tighten all jam nuts.

(d) In the closed position all flaps should be equidistant from the accessory cowling. The preferred distance is 1 inch ± ¼ inch.

(e) If all the flaps are adjusted too far closed or too far opened, disconnect the clevis pins on either side of the actuating cylinder and adjust equally.

(f) If the clevis is shortened on one side, the other side should be lengthened an equal amount.

6. POWER PLANT.

a. GENERAL.

(1) C-47 and C-47A airplanes are furnished flight power by two R-1830-92, Pratt & Whitney engines. These 14-cylinder, Twin Wasp engines are mounted on the forward face of the fire wall and covered by engine cowling. Fuel is supplied to the engine by a Bendix-Stromberg injection-type carburetor. Several engine-driven accessory units are mounted on the engine rear section. Ignition is distributed to cylinder spark plugs by two American Bosch magnetos. On some airplanes, two Scintilla magnetos are used. The

KEY TO FIGURE 196—Con't

Item	*Part No.*	*Part Name*	*Per Assembly*
	AN3-15	Bolt	10
	AN3-3	Nut	10
4	2114316	Lever	2
5	AN3-6	Bolt	28
	AN310-3	Nut	28
6	1119730	Swivel	12
	AN3-14	Bolt	12
	AN310-3	Nut	12
7	1119086	Swivel	2
8	1119099 and -2	Swivel (LH and RH)	1 each
9	1119090	Coupling Sleeve	1
10	1119091	Coupling Spring	1
11	1119092	Coupling Body	1
12	1119089	Coupling Assembly	3
	1119088	Coupling End	3
	AN316-4R	Check Nut	3
	AN316-4L	Check Nut	3

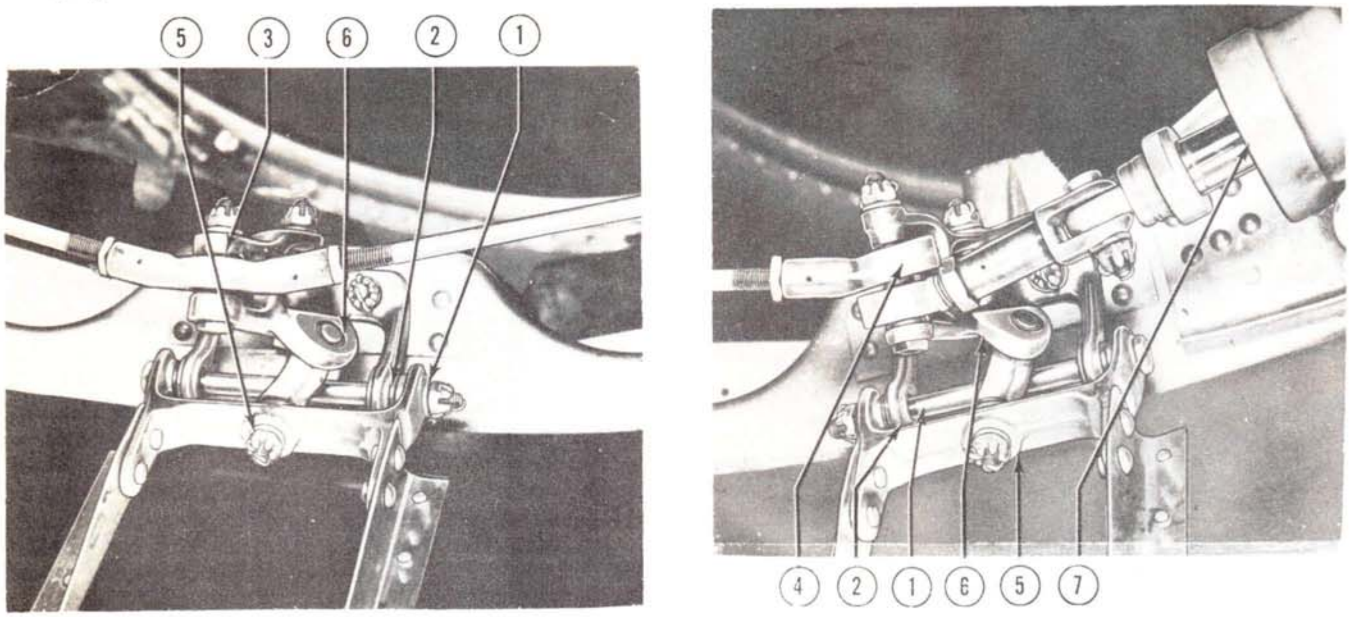


Figure 197—Cowl Flap Linkage Bushing Data

Item	*Part No.*	*Part Name*	*No. Req. Per Assembly*
1	131736-3C-010	Bushing	2
2	1114312	Cowl Flap Actuating Mechanism Bushing	2
3	1114312	Cowl Flap Actuating Mechanism Bushing	1
4	1114312	Cowl Flap Actuating Mechanism Bushing	1
5	1116465	Cowling Flap and Hinge Support Base Bushing	1
6	1116464	Cowling Flap and Actuating Lever Support Bushing	2
7	1119089	Cowl Flap Operating Cylinder Bushing	2

ignition harness and spark plugs are shielded to prevent radio interference. Cables connect operating levers in the pilots' compartment with control units on the engine to govern carburetor mixture, throttle, and carburetor hot air positions. This paragraph includes instruction for performing top overhaul work only. A detailed description is included for removal of a complete engine, as well as for interchanging C-47 and C-47A power plant groups.

(2) C-47B airplanes are powered by two R-1830-90C Pratt & Whitney engines having the same general characteristics and accessories as those on C-47A airplanes with the exception of two-speed superchargers. These superchargers enable these airplanes to operate more efficiently at higher altitudes than C-47A's. Engines on C-47B airplanes are not interchangeable with engines on other C-47 type airplanes. When C-47B airplanes are modified to incorporate R-1830-90D engines, these airplanes become C-47D series airplanes.

b. ENGINES.

(1) ENGINE ASSEMBLY.

(a) DESCRIPTION.—On C-47 and C-47A airplanes, Pratt & Whitney, R-1830-92 aircraft engines are mounted on the forward face of each nacelle. On C-47B airplanes, Pratt & Whitney, R-1830-90C engines are installed in the same fashion. The conversion of R-1830-90C engines consists of removal of the two speed clutch and installation of single speed gear drive ratio. These Twin Wasp engines have the following characteristics:

1. 14 cylinders arranged in two banks of seven each.

2. Radial design, air-cooled.

3. Compression ratio 6.7:1.

4. 1050 hp at 2550 rpm at sea level.

5. 1050 hp at 2550 rpm at 7500 feet altitude for C-47 and C-47A airplanes.

6. 1000 hp at 2500 rpm at 12,500 feet altitude for C-47B airplanes using high blower.

7. 1200 hp at 2700 rpm at sea level take-off.

8. 1830 cubic inches of cylinder displacement.

The following information is given in order of engine disassembly for a top overhaul procedure.

(b) REMOVAL.

1. Remove the engine and engine accessory cowling, as described in paragraph 5.*c.* and *d.,* this section.

2. Remove the propeller, as instructed in paragraph 7., this section.

3. Drain the oil at the Y-drain (on some airplanes a system drain located on the forward side of the fire wall). (See D, figure 265.)

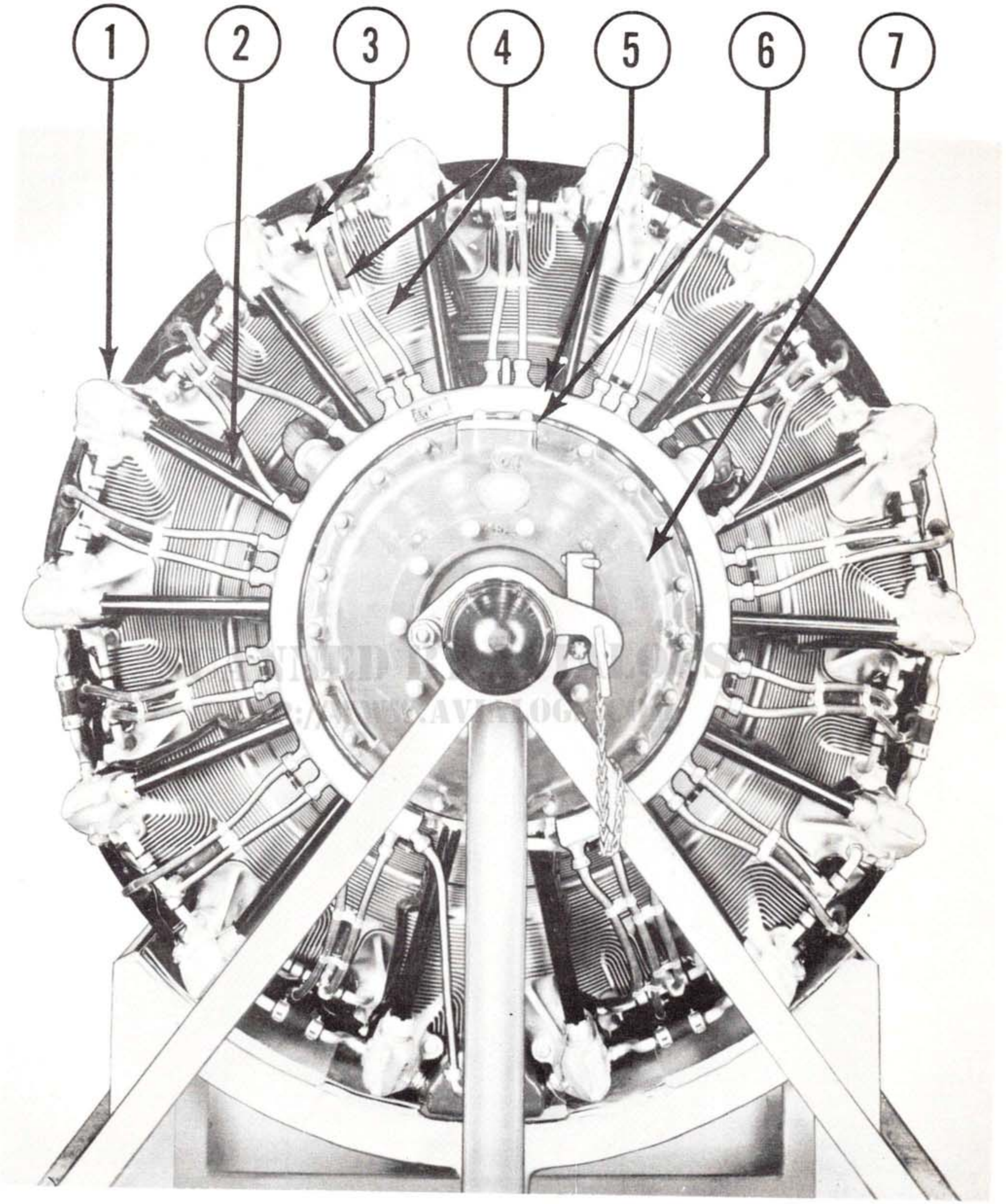


Figure 198—Front View of Engine

1. Valve Rocker Box
2. Push Rod Cover Tube
3. Rocker Box Oil Drain Pipe
4. Spark Plug Ignition Conduits
5. Ignition Harness
6. Propeller Governor Mounting Pad
7. Engine Nose Case

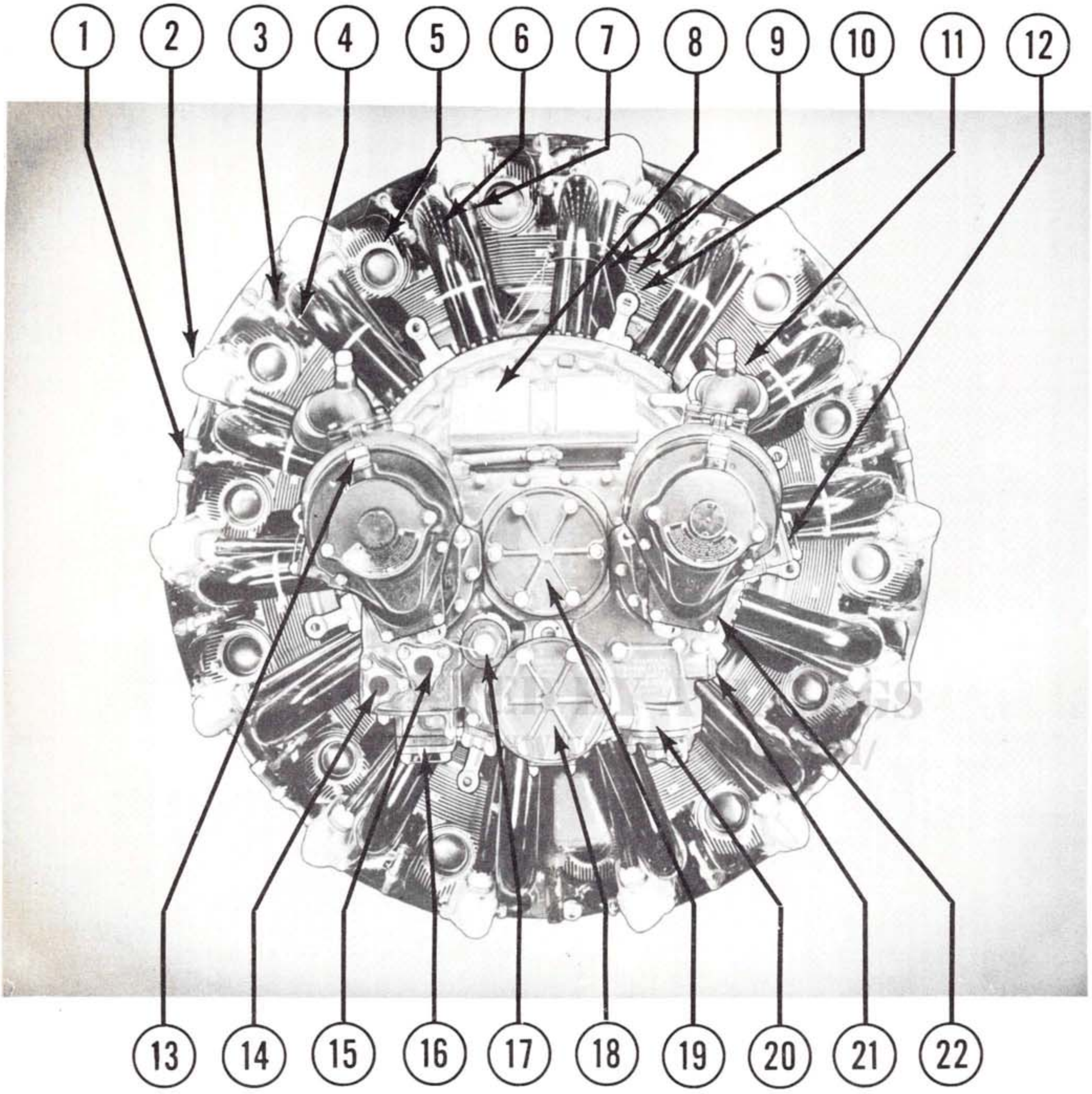


Figure 199—Rear View of Engine

1. Rocker Box Intercylinder Oil Drain Pipe
2. Valve Rocker Box
3. Spark Plug Lead Elbow
4. Spark Plug
5. Cylinder Exhaust Port
6. Intake Pipe
7. Push Rod Cover Tube
8. Carburetor Mounting Pad
9. Fuel Primer Lines
10. Engine Mount Attachment Bracket
11. Ignition Conduit
12. Auxiliary Drive Gear Mounting Pad
13. Magneto Ground Connection
14. Oil Inlet Port
15. Oil Outlet Port
16. Fuel Pump Drive
17. Oil-Pressure Relief Valve and Temperature Compensating Piston
18. Generator Mounting Pad
19. Starter Mounting Pad
20. Oil Strainer Chamber
21. Oil Strainer Bypass Valve
22. Magneto

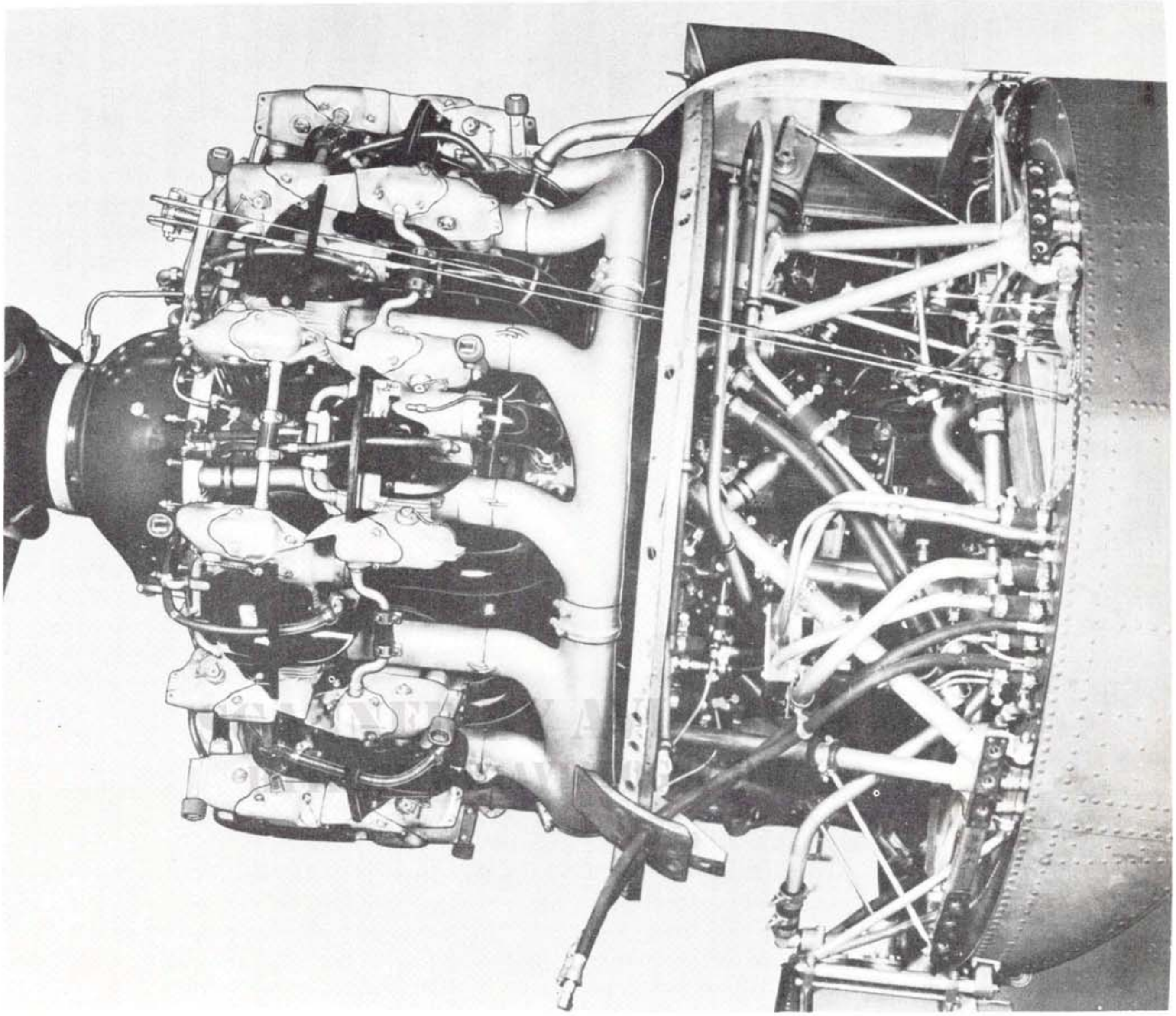


Figure 200—Engine Installed (Inboard)

4. Remove the two vent lines from the crankcase.

5. Disconnect the oil line from the engine at the oil cooler.

6. Disconnect the inboard and outboard oil vent lines at the first hose forward of the fire wall.

7. Disconnect the main fuel line at the hose at the fire wall.

8. Disconnect vapor separator line at fire wall.

9. Disconnect the hydraulic pressure and suction lines at the self-sealing coupling on the fire wall. Plug the flexible hose ends.

10. Disconnect the engine fire extinguisher line by unscrewing the collar forward of the fire wall. Leave the short flexible line attached to the fire wall.

11. Disconnect the line from the vacuum pump at the fire wall.

12. Disconnect the propeller governor oil line at the flexible line at the fire wall and plug the line.

13. Disconnect the oil "IN" and "OUT" lines at the hose at the fire wall.

14. Disconnect the cowl flap hydraulic lines at the fire wall. This will free the hoses since they were disconnected from the actuating cylinders when the engine cowling was removed.

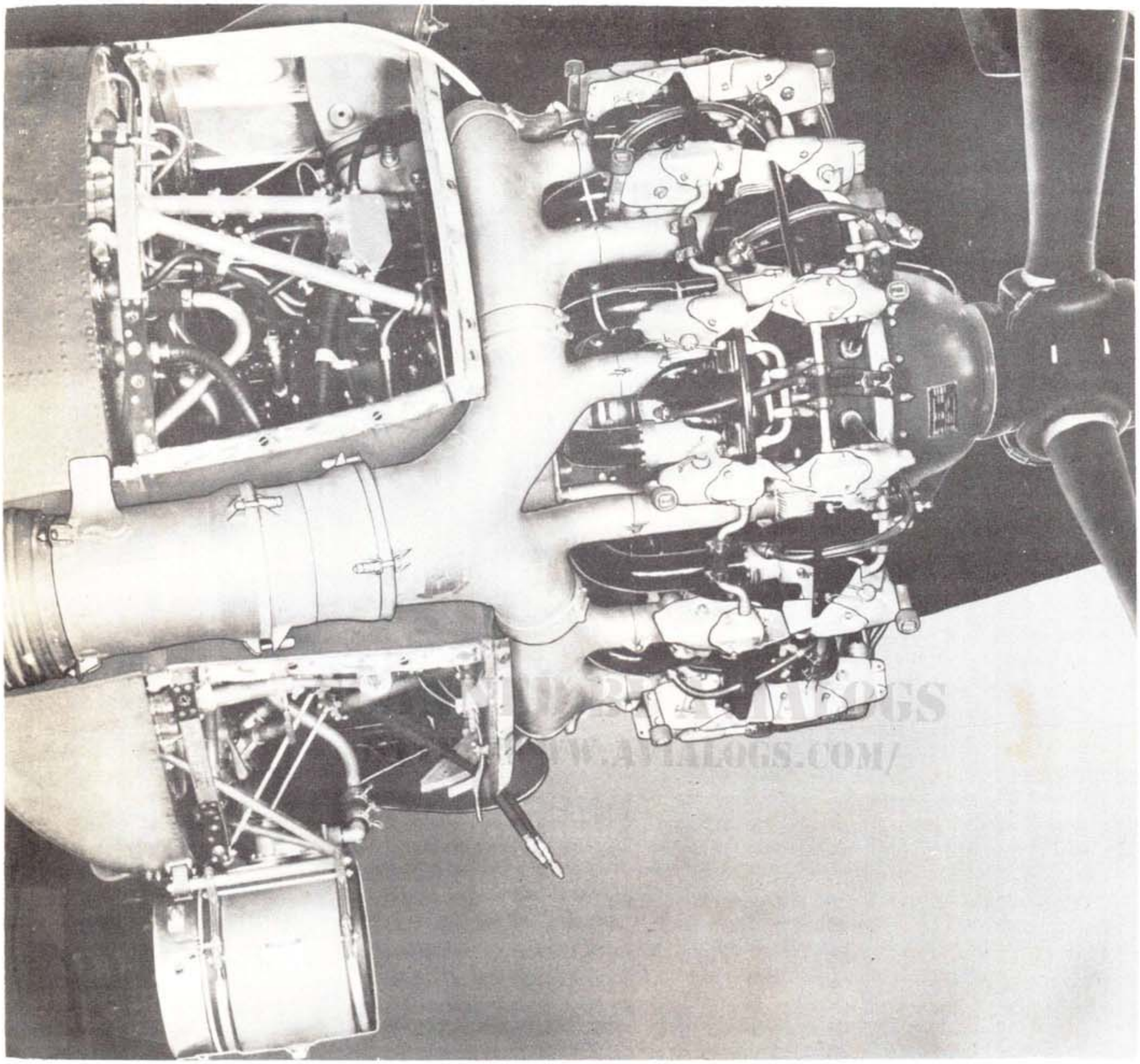
15. Disconnect the carburetor vapor return line at the hose forward of the fire wall.

16. Disconnect the oil pressure hose at the fire wall.

17. Disconnect the fuel pressure hose at the carburetor.

18. Disconnect the propeller anti-icer line at the fire wall.

19. Disconnect the pressure cross-fed line at the fire wall.



AVIALOGS

Figure 201—Engine Installed (Outboard)

20. Disconnect the manifold pressure line at the fire wall.

21. Disconnect the engine primer line at the fire wall.

22. Disconnect the propeller control cables at the turnbuckles forward of the fire wall.

23. Disconnect the electrical conduit at the fire wall.

24. Disconnect the carburetor air, mixture, and throttle control rods at the bell cranks on the fire wall.

25. Disconnect the ignition, starter, and generator conduits at the fire wall disconnect plug.

26. Attach the hoist sling to the hoist eyes provided on the engine (See figure 109.)

27. Disconnect the exhaust ring from the tail pipe, as instructed in paragraph *6.c.*(5), this section.

28. Unscrew the four engine mount bolts, but do not remove them. Approximately four and one-half turns are required to free the bolts.

29. Remove the lower engine mount bolts. Make sure that everything is clear and that hoist attachments are tight.

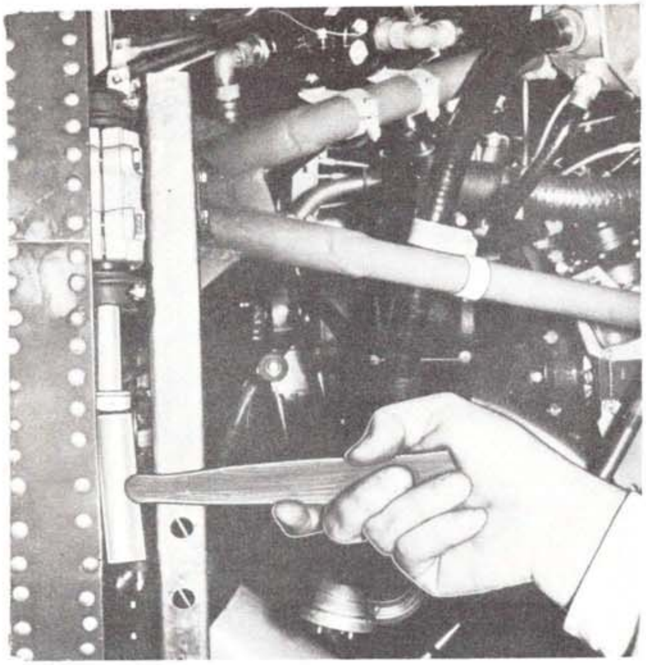


Figure 202—Installing Engine Mount Attachment Bolt

30. Remove the two upper bolts and swing the engine forward about 4 inches to clear the exhaust stacks.

(b) REAR CASE.—The rear case incorporates bronze bushings which support the rear ends of the accessory, impeller intermediate, generator intermediate, and generator drive gears. A housing in each side of the rear case supports a tachometer intermediate drive gear which drives a tachometer drive gear and an auxiliary drive gear.

1. Other bushings in the rear case support the vacuum pump drive gear and front ends of the magneto drive gears. This case houses the rear oil pump, an oil thermostat, and a compensating oil pressure relief valve, and incorporates flanges for mounting a starter, generator, two magnetos, a vacuum pump, two tachometers and two auxiliary accessories.

2. With the exception of the generator and vacuum pump, all accessories are driven through two impeller intermediate drive pinions which are driven by the accessory drive gear.

3. The tachometer intermediate drive gears are mounted in housings at the right and left sides of the rear case. Each of these gears incorporates an integral bevel gear, an integral spiral gear and a spur gear. The spur gear is splined to the shaft and drives an auxiliary drive gear. The integral bevel gear meshes with and is driven by the corresponding magneto drive gear, while the integral spiral gear drives the corresponding tachometer drive case. Two of the tachometer drive gears are mounted in the rear case, and are driven by the spiral gears of the tachometer intermediate drive gears.

(c) INSPECTION AND CLEANING OF AUXILIARY DRIVES.—Due to numerous failures of the right- and left-hand auxiliary drives because of metal pick-up and heat resulting from lack of lubrication, oil passages in and to the auxiliary drives in the rear crank case section (see figure 202A) will be inspected and cleaned as follows:

1. Remove the spacer assembly from both sides of the engine. On drives on which a hydraulic pump or some other accessory is mounted, it will be necessary to remove the small drain line in the bottom of the pump and the seven nuts that hold the spacer to the engine. The complete hydraulic pump and spacer assembly can then be removed as one complete unit.

2. On auxiliary drives that do not have an accessory mounted, it will only be necessary to remove the seven nuts. The spacer assembly can then be removed by hand. In most cases the drive shaft will remain in the spacer assembly when it is removed. If not, it can be removed by hand from the vacuum pump and tachometer drive adapter. Also remove by hand the vacuum pump drive gear from the vacuum pump drive control shaft to allow an unobstructed view of the inner parts of the assembly.

3. Inspect the spacer assembly to determine if same has been receiving adequate lubrication. If bushings are found to be dry, etc., wash the spacer assembly in cleaning solvent, Specification No. P-S-661. Vacuum pumps or other accessories which may be mounted on the spacer assemblies must be removed prior to washing in solvent. Blow out the oil passages of all spacer assemblies to insure they are clear.

4. Insert a piece of safety wire into the oil passages in the rear crank case section of the engine that supplies oil to the spacer assembly (see figure 202A). If the passage is unobstructed, the wire will bottom 3¾ inches from the mating surface.

5. Insert a fine wire (approximately .017-inch diameter) as far as possible into the oil passage in the adapters. The wire will pass down between the shaft and adapter and should bottom at approximately 3 inches from the opening in the adapter.

Note

> Before inserting the wire into this passage, file or grind the end of the wire to remove all sharp edges or burrs which may score the vacuum pump drive shaft.

6. Insert one end of a 2- to 3-foot length of hose, Specification No. MIL-H-6000(1), in the opening in the adapter from which the vacuum pump drive shaft was removed. Holding the opposite end of the hose as high as possible above the adapter, fill the hose with cleaning solvent, Specification No. P-S-661. Apply air or fluid pressure to the cleaning solvent with some suitable device which will force the cleaning solvent through the passages. Normally the pressure required will not exceed 10 psi. Upon applying pressure, a stream of cleaning solvent should issue from the opening that supplies oil to the spacer assembly (see figure 202A). Flush until the cleaning solvent flows clean and any sludge tending to block the passages has been washed out. A suitable device may be an air hose adapter to apply pressure to the solvent filled hose, a spray gun used around all hangar and line installations for aircraft and engine

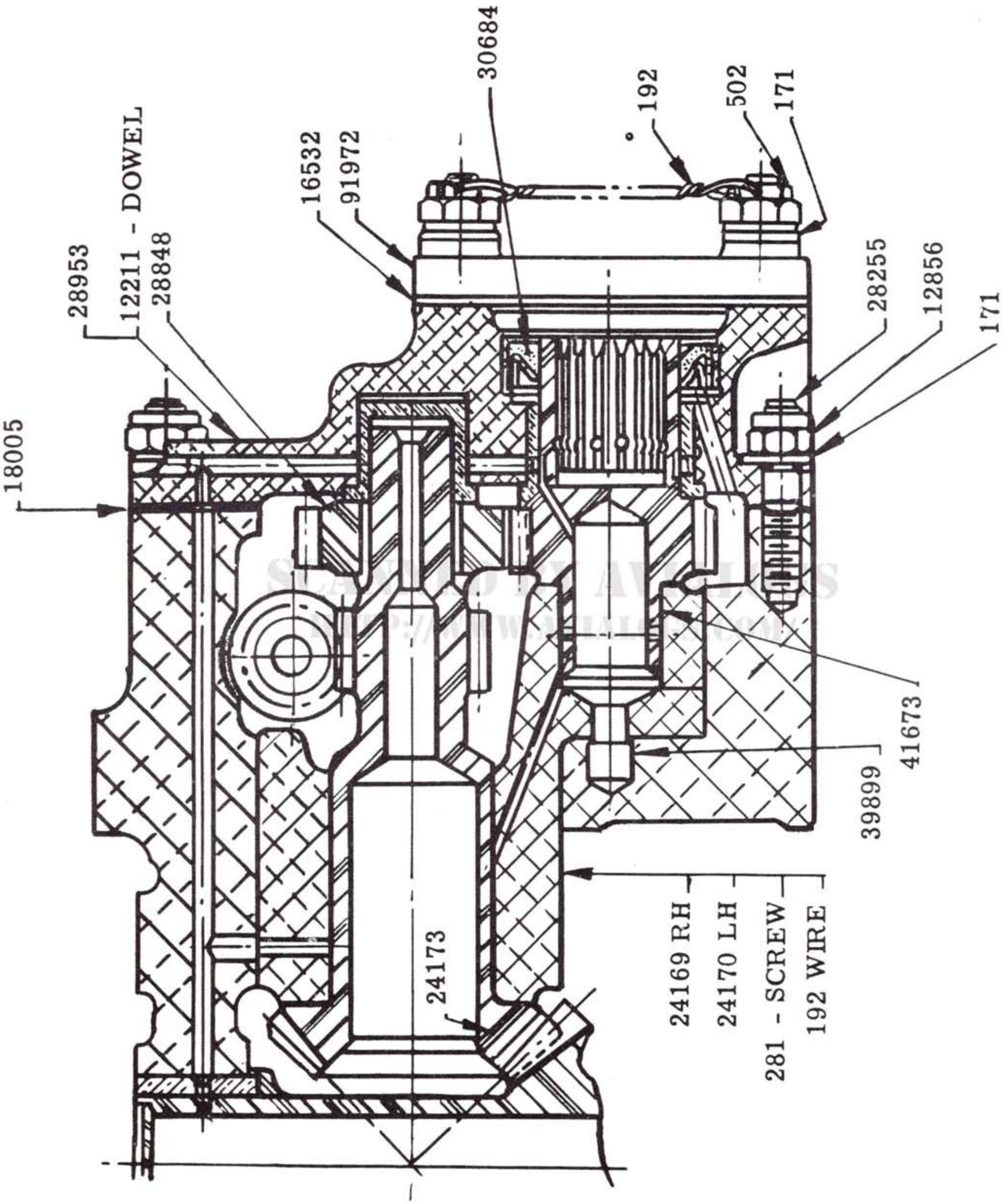

18005
28953
12211 - DOWEL
28848
16532
91972
30684
192
502
171
28255
12856
171
41673
39899
24169 RH
24170 LH
281 - SCREW
192 WIRE
24173

Figure 202A—Dual Auxiliary Drives

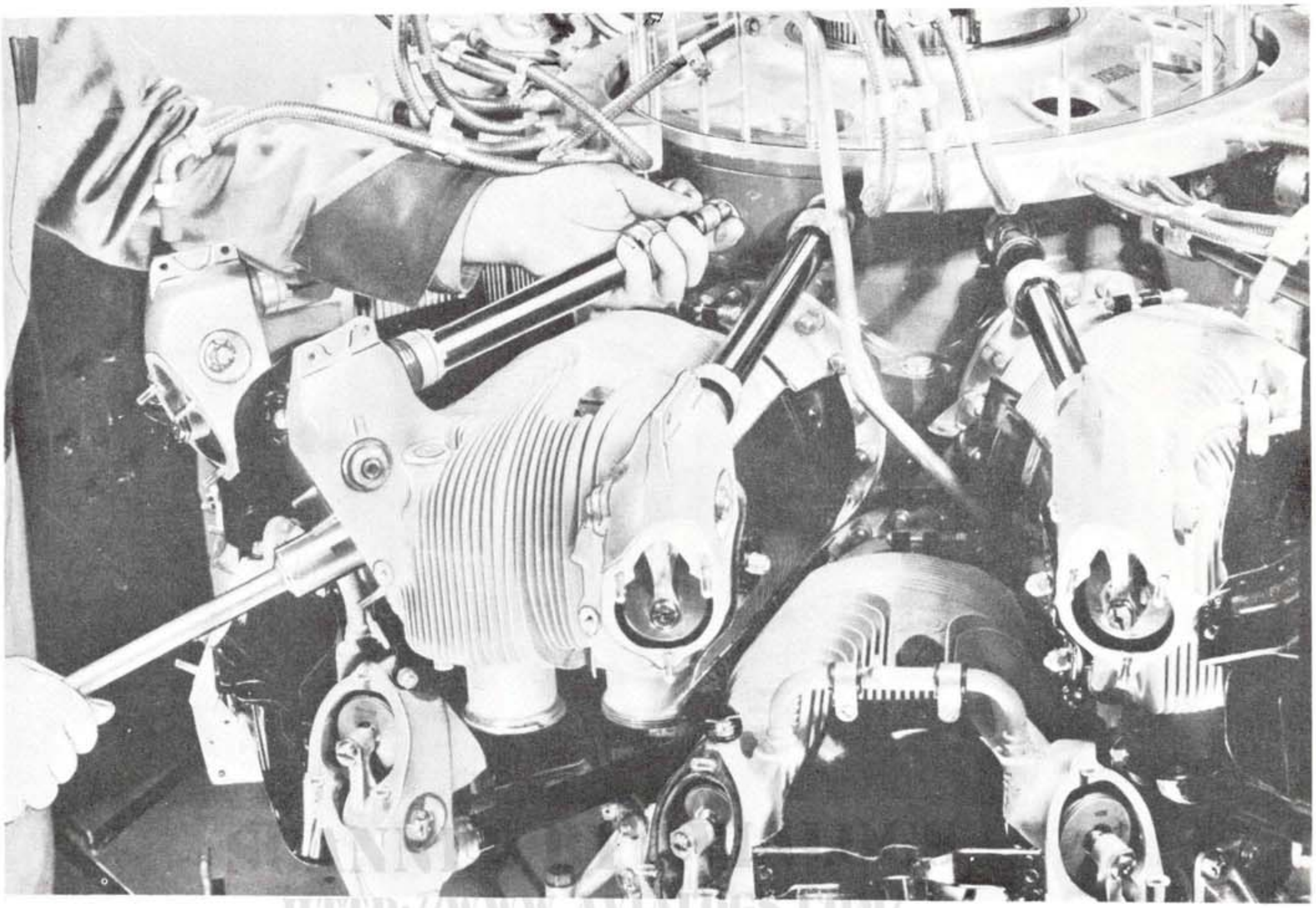


Figure 203—Removal of Push Rod

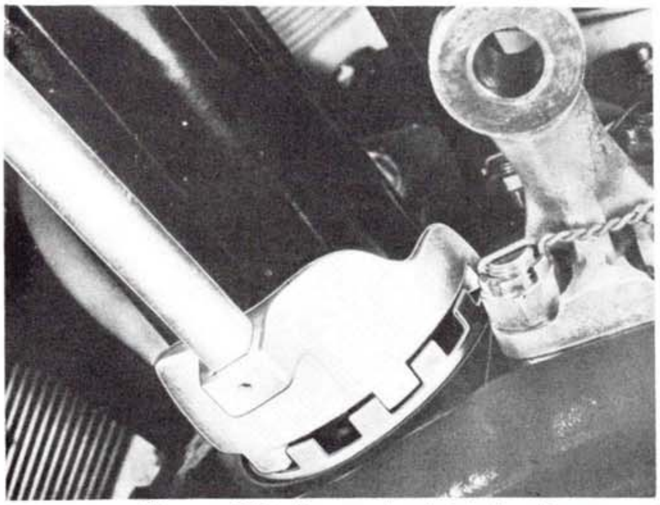


Figure 204—Removal of Intake Pipe

cleaning purposes, or any plunger type squirt gun which will permit positive pressure application to the solvent.

7. Recheck the oil passages with the wire, as described in steps d and e, to make doubly sure they are clear of any obstructions.

8. While the spacer assembly is still removed, turn the engine over with the starter a sufficient number of times to check whether oil flows into the drive housing and out of the hole supplying oil to the spacer assembly.

9. Lubricate all parts with clean engine lubricating oil and assemble, making sure that the drive shaft is fully bottomed and flush with the bushing in the spacer assembly before attempting to install the spacer assembly on the engine.

CAUTION

Care will be exercised not to damage the seal during assembly.

Note

If this inspection reveals that one or more of the auxiliary drive parts has become unserviceable because of lack of lubrication, etc., no attempt will be made to replace subject parts, instead the engine will be changed.

(c) INTERCHANGING ENGINE GROUPS FOR C-47 and C-47A AIRPLANES.—The only differences between the C-47 and C-47A power plants are in the electrical system. Therefore, it is necessary to remove from the power plant (regardless of model) plugs, conduit, and electrical boxes. When removing

the booster coil (C-47) or induction vibrator (C-47A) from either engine, be sure to remove the mounting attachment which secures these units to the engine mount truss. When removing the starter the hand-cranking and hand-meshing equipment must be completely removed. Since the temperature resistance bulbs, the tachometer, the propeller feathering pressure cut-out switch, and the engine thermocouple connections are identical on both models, it will be necessary only to remove the connections and not to interchange or remove these units.

1. Disconnect the starter plug, generator plug, ignition plug, and the engine electrical instrument plug at the fire wall.

2. Unfasten all clamps which secure the accessory section electrical conduit to the engine accessory section.

3. Disconnect the conduit from the magnetos.

4. Remove the starter and generator from the engine.

5. Remove the friction tape and unfasten the thermocouple connections from cylinder 1 (r-h) and 13 (1-h). Pull the wires through the engine diaphragm.

6. Disconnect the propeller feathering pressure cut-out switch wire (No. SR22 1-h, or No. SR11 r-h) at the spliced connection inside the engine section pull box (figures 449 and 461). Uncouple the conduit at the pull box and allow this conduit to remain attached to the engine diaphragm.

7. Disconnect the plugs from the carburetor air and the oil temperature resistance bulbs and the tachometer magnetos.

8. Remove all conduit clamps and the induction vibrator or booster coil with its mounting. The complete engine electrical section distribution harness can be removed from the airplane and the engine is ready to be removed.

Note

The electrical equipment which has been disconnected or removed from the engine will remain with the airplane. When the interchanged engine is secured to the airplane, it will be necessary only to reinstall the electrical distribution harness, starter, and generator, and make the necessary plug connections. DO NOT attempt to interchange 12- and 24-volt equipped power plants if a correctly equipped spare power plant is available.

(2) PUSH RODS.

(a) DESCRIPTION.—Tappets located in the crankcase section actuate the valve rocker arms through tubular, aluminum-alloy push rods. The push rods have hardened steel ball ends which fit into hardened steel sockets in both the tappets and the rocker arm. The rods are protected by removable, oiltight cover tubes which are held in place at both ends by packing and gland nuts.

Note

Refer to paragraph 5.*d.*, section III, for list of engine special service tools provided for maintaining and servicing engines between overhauls.

(b) REMOVAL.

1. Remove any cowling necessary to make the part accessible, as described in paragraph 5.*c.* and *d.*, this section.

2. Loosen the push rod cover gland nuts, using PWA-1424 wrench.

3. Loosen and remove the rocker box cover.

4. Turn the propeller shaft until the piston of the cylinder being worked on is at top dead center of its compression stroke.

5. Depress the valves (figure 203), using PWA-455 rocker arm depressor and remove the push rods and cover tubes.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Test the push rod for straightness by rolling it over a flat surface.

2. Examine push rod ball ends for looseness and wear. A clear ringing sound when a push rod is dropped on a bench indicates that the ball ends are tight.

3. Replace cracked or distorted push rods.

4. Examine push rod covers for cracks, especially at the ends.

5. In case of oil leakage, or damage to the push rod tube packing gland threads, remove the gland and replace. Replacement glands should be .004-inch oversize to insure a tight fit and prevent oil leakage.

6. If any of the steel ferrules in the ends of the push rod cover tubes becomes loose, replace the cover tube.

(d) INSTALLATION.—Before installation, apply a thin even coat of insulating compound (Specification No. AN-C-128) to the oil seal packing rings.

1. Install the packing rings in each gland nut.

2. Assemble the push rod and cover assembly with the marked end of the push rod and the flared end of the cover tube toward the crankcase.

3. Depress each rocker with PWA-455 depressor and fit the corresponding push rod and cover into position.

4. If the valve tappet protrudes too far to allow installation of its push rod, turn the propeller until the tappet has receded sufficiently to permit installation.

5. After the push rod and cover assembly are in place on the engine with the gland nuts secured fingertight, push the cover tube firmly against its seat on the tappet guide. Turn down the gland nut and tighten to a torque of 125 to 250 inch-pounds, using PWA-3013 wrench.

6. Tighten the gland nut on the cylinder head end of the cover tube to the same torque, and lock wire both nuts.

CAUTION

Never reverse the above sequence of operations as the packing on the tappet guide end might be pushed into the tappet compartment and be mutilated during engine operation.

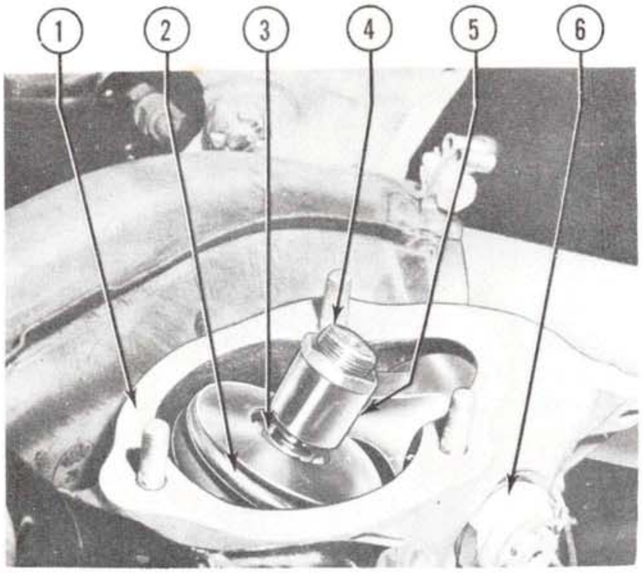


Figure 205—Rocker Arm Installed

1. Rocker Box
2. Valve Spring
3. Valve and Split Lock
4. Valve Clearance Adjustment Screw
5. Rocker Arm
6. Rocker Arm Shaft and Shaft Nut

7. If the push rod cover was not removed from the crankcase, install the marked end of the push rod toward the crankcase and guide the push rod into the rocker socket while the cylinder is being installed on its pad.

(3) INTAKE PIPES.

(a) DESCRIPTION.—Fourteen steel intake pipes (figure 204) are connected by packing nuts to the outlet ports of the blower case and to the inlet ports of the cylinders.

(b) REMOVAL.—Loosen the gland nut at the cylinder end and at the blower case end and remove intake pipe.

CAUTION

The intake pipes are constructed of thin gauge steel which is easily dented or damaged if not handled carefully.

(c) INSPECTION.

1. Inspect for dents or cracks.

2. Check the condition of paint.

3. Examine the nuts for breaks and the condition of threads.

4. Replace the packing if it is not in good condition.

(d) INSTALLATION.

1. Install the packing and packing nut at the blower end and a small rubber seal, packing, and packing nut at the cylinder end of the intake pipe after first coating the seal with a thin even coat of insulating compound (Specification No. AN-C-128).

2. Place the intake pipe in position on the engine and install the lower packing nut loosely in the blower housing.

3. Install the upper packing on the unions of the cylinder inlet ports and tighten with PWA-5072 wrench.

4. Tighten the nuts on the blower end of the intake pipe using PWA-5072 wrench.

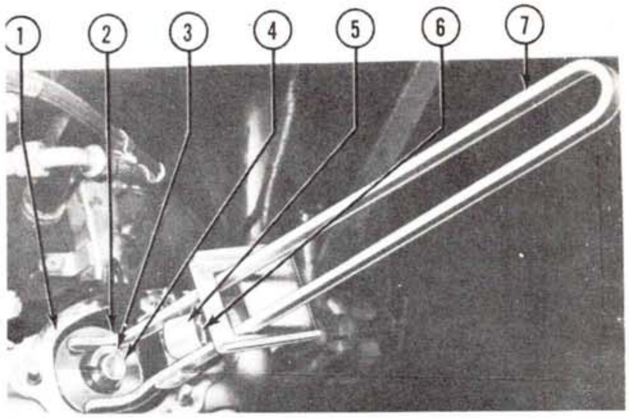


Figure 206—Valve Spring Compressor in Use

1. Rocker Box
2. Valve Spring
3. Valve Split Lock
4. Valve
5. Rocker Arm
6. Valve Clearance Adjustment Screw
7. Valve Compressor Tool

(4) ROCKER ARMS AND BOXES. *(See figure 205.)*

(a) DESCRIPTION.—The two rocker housings on the cylinder heads each contain two concentric valve springs and a valve rocker arm. Each pair of valve springs is secured to its valve stem by a split cone and washer. The exhaust and inlet valve springs are interchangeable and may be withdrawn from the housings without removing the rocker arms. Safety circlets are fitted on the valve stems to avoid possibility of the valves dropping into the cylinders when the split cones are installed or removed. Each rocker arm is supported on a shaft by means of a double row ball bearing and has a valve clearance adjustment screw. Drilled passages in each rocker arm direct pressure oil to the ball-bearing and valve adjusting screw. Rocker box covers are secured by studs and elastic stop nuts to the tops of the rocker housing. Oil drain pipes connect the two rocker boxes of the cylinders located below the horizontal centerline of the engine.

(b) REMOVAL.

1. Remove the elastic stop nuts which hold the rocker box cover in place. Do not remove the cover gasket.

2. Remove the push rod, as described in paragraph 6.*b.*(2)*(b)* preceding.

3. Unscrew the cap and lift the copper gasket from the bushing which supports the inner end of the rocker arm shaft.

4. Remove the cotter and unscrew the nut from the opposite side of the shaft.

5. On cylinder 8, remove the nut from the inner bushing, and remove the insert from the end of the rocker arm shaft.

6. Using a suitable drift and hammer, drive the shaft out of the rocker box. The rocker arm will fall free inside.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. If any binding is present which prevents a rocker arm from moving freely, remove it and inspect the bearing. Clearance between the rocker shaft bushings and the side of the rocker arm should not exceed .015 inch.

2. Check the valve adjusting screw assemblies for burred threads. Inspect the half ball for unusual

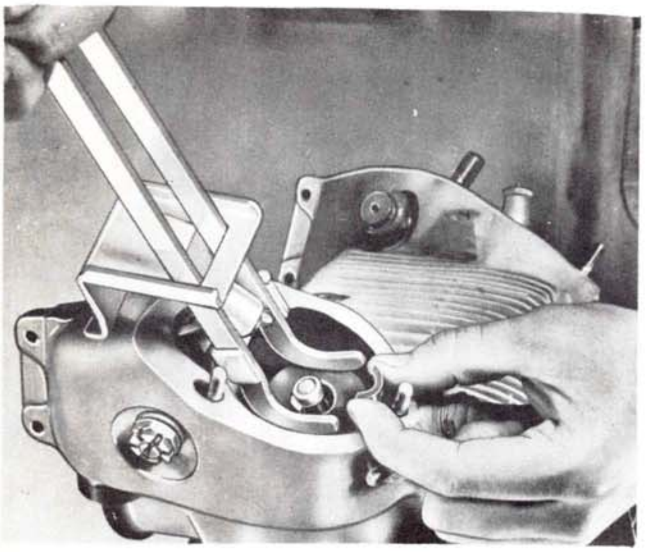
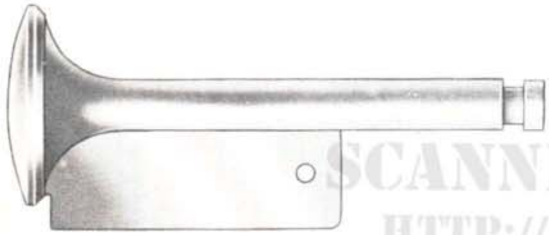
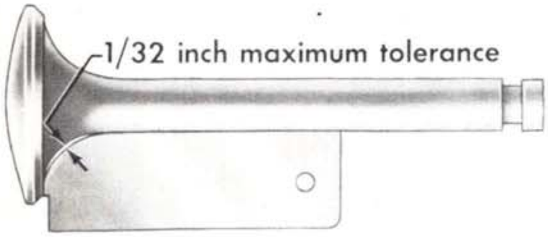


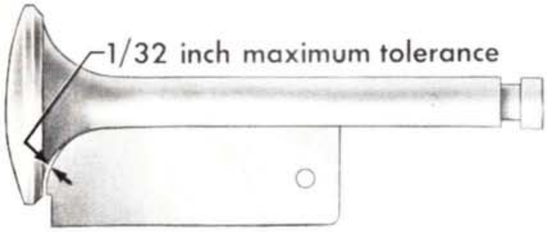
Figure 207—Installing Split Lock on Exhaust Valve Stem



A Correct Valve-Gage Fit



B Valve Stem Elongated



C Valve Head Radius Incorrect

Figure 208—Valve Radius Stretch Gage

wear, looseness in its socket, nicks, or a pitted condition. Inspect the screws for cracks.

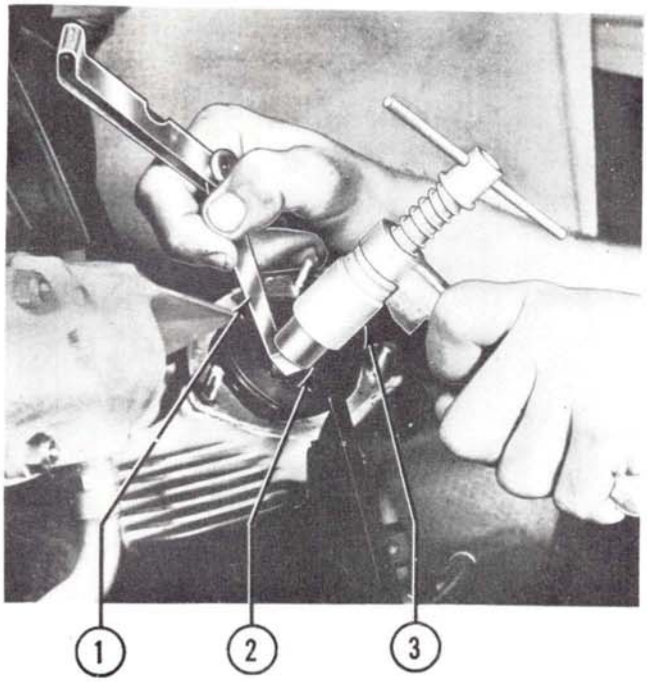


Figure 209—Adjusting Valve Clearances

1. Valve Clearance Feeler Gage
2. Rocker Arm
3. Valve Clearance Adjustment Tool

3. Take special care when installing rocker box covers to avoid damaging the gaskets. Regardless of how slight the damage, replace damaged gaskets with Pratt & Whitney part No. 88962, which is a neoprene gasket. Remove all evidence of oil, grease, gasoline and sealing compounds before it is installed.

4. Face the rocker box covers on a lapping plate with a small amount of lapping compound, if necessary. This insures that the cover bears evenly on the gasket and prevents oil leakage. Wash the covers thoroughly to remove all lapping compound.

5. If only part of a new set of rocker arms are installed, always put them on the exhaust valves, since these are subjected to greater heat and wear.

(d) INSTALLATION OF ROCKER ARM, VALVE SPRINGS, AND ROCKER BOX COVERS.

1. Insert the rocker arms in position. Drive the shaft into position with a suitable drift.

2. Install the rocker shaft oil seal, flat washer, and castellated nut. Tighten the nut to 200-250 inch-pounds torque. Install the cotter pin.

3. Place a copper sealing gasket on the rocker shaft bushing. Install the rocker shaft cap and tighten to a torque of 175-200 inch-pounds.

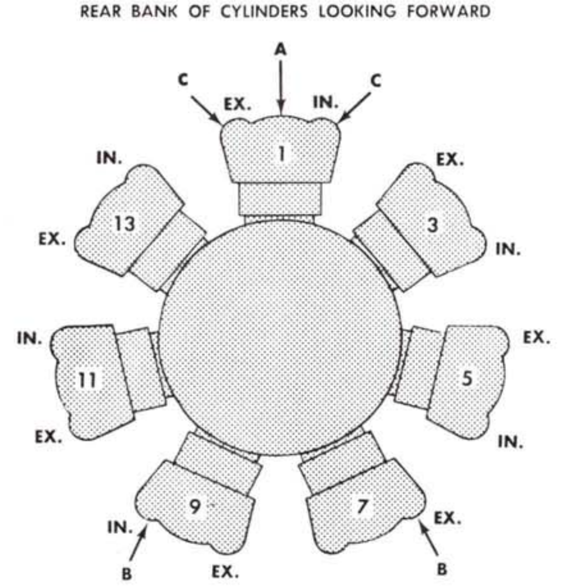
Note

On No. 8 cylinder rocker shafts, place a rubber oil seal on the shaft inserts before installing the gasket and special rocker shaft caps.

4. If the valve springs were removed, insert the lower washers and valve springs in the rocker housing.

5. Fit the upper washers over the springs.

6. If the cylinder is removed from the crankcase, place it over a wooden block (having the same contour as the dome of the cylinder head) to hold the valves in place when the springs are compressed for installation.



A—SET TO TOP DEAD CENTER ON COMPRESSION STROKE
B—MOMENTARILY DEPRESS THESE VALVES SIMULTANEOUSLY.
C—SET THESE VALVE TAPPETS

To Adjust Valves		Set Piston On	Depress Valves*	
INTAKE	EXHAUST	TOP DEAD CENTER	INTAKE	EXHAUST
1	1	1	9	7
10	10	10	4	2
5	5	5	13	11
14	14	14	8	6
9	9	9	3	1
4	4	4	12	10
13	13	13	7	5
8	8	8	2	14
3	3	3	11	9
12	12	12	6	4
7	7	7	1	13
2	2	2	10	8
11	11	11	5	3
6	6	6	14	12

* Depress these 2 valves simultaneously. Then release them slowly before adjusting valves with piston in top dead center position

Figure 210—Valve Clearance Adjustment Table

7. Compress the valve springs (figure 206) with PWA-459 valve spring depressor, and install the split locks (figure 207).

8. Before installing the rocker box cover, adjust the valves. (Refer to "Adjustments of Valves" paragraph 6.*b.* (4) *(e)*.)

9. Install rocker box covers and new gaskets. Tighten the retaining nuts evenly to prevent possible oil leaks. If neoprene cover gaskets are used, install them with the mating surfaces thoroughly dry and free from oil and grease. When neoprene gaskets are used, tighten the cover nuts to a torque of 60 to 75 inch-pounds. Use no sealing compound of any kind with this gasket. If other types of gaskets are employed, use gasoline and oil-resistant grease (Specification No. AN-G-14) to seal the gaskets.

(e) ADJUSTMENTS OF VALVES.

Note

The following procedure is given to adjust the valves of cylinder 1. Using figure 210, follow this procedure for adjusting all valve clearances.

1. Unscrew the valve clearance adjusting screw several turns to insure that all clearances are loose.

2. Using the top dead center indicator, place the piston for cylinder 1 in exact top dead center of its compression stroke. If all valves are being adjusted, always start with cylinder 1. Turn the crankshaft in the direction of normal rotation (clockwise looking forward) for all timing operations.

3. Momentarily depress the valve springs on intake 9 and exhaust valves 7 (figure 210) by using rocker arm depressors. The pressure should be relieved slowly and both depressor tools should be lifted off simultaneously.

CAUTION

Be certain that the proper valves are depressed as indicated in figure 210. Depressing the wrong valves may cause a push rod to drop out of place and cause damage before it is discovered. NEVER depress a valve that is not at least half opened.

4. Insert a .020 inch feeler gage (figure 209) between the ball tip of the adjusting screw and the top of the valves of cylinder 1. Adjust the screw until the clearance at this point is .020 inch, then tighten the lock nut.

5. After tightening the lock nut to a torque value of 300 to 350 inch-pounds, recheck the clearance.

6. When all valve clearances have been set in the order shown in figure 210, turn the crankshaft two revolutions and recheck each adjustment, being sure that the piston for the valve being checked is in the top dead center position.

7. When making this check if any clearances vary more than .005 inch from .020 inch, they should be reset.

(5) CYLINDERS.

(a) DESCRIPTION.—Each cylinder is constructed of a cast aluminum alloy head and a forged steel barrel. The head is screwed and shrunk on the

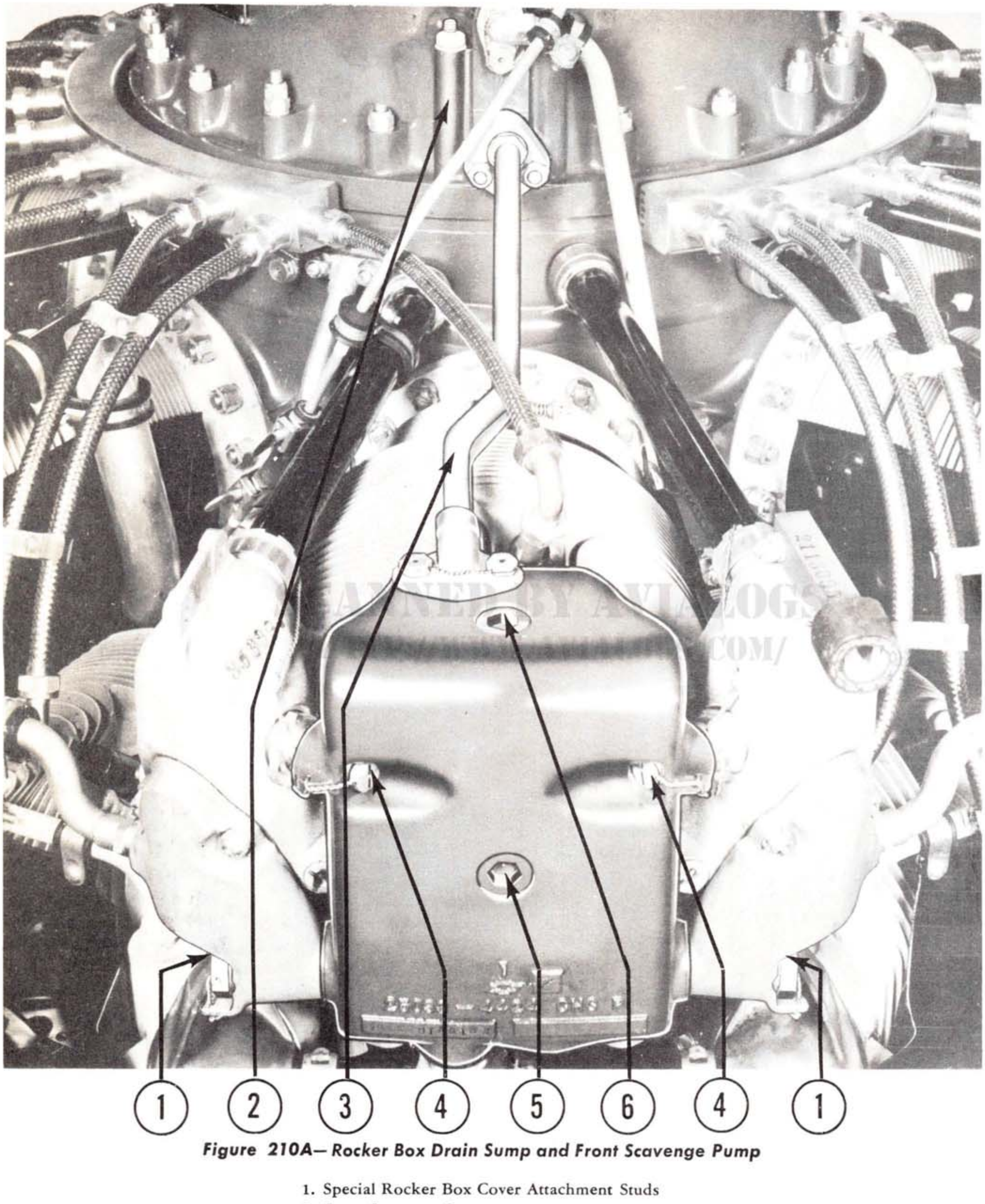


Figure 210A— Rocker Box Drain Sump and Front Scavenge Pump

1. Special Rocker Box Cover Attachment Studs
2. Front Scavenge Pump
3. Scavenge Line—Sump to Pump
4. Rocker Arm Shaft Attachment Bolts
5. Sump Drain Plug
6. Sump Drain Plug

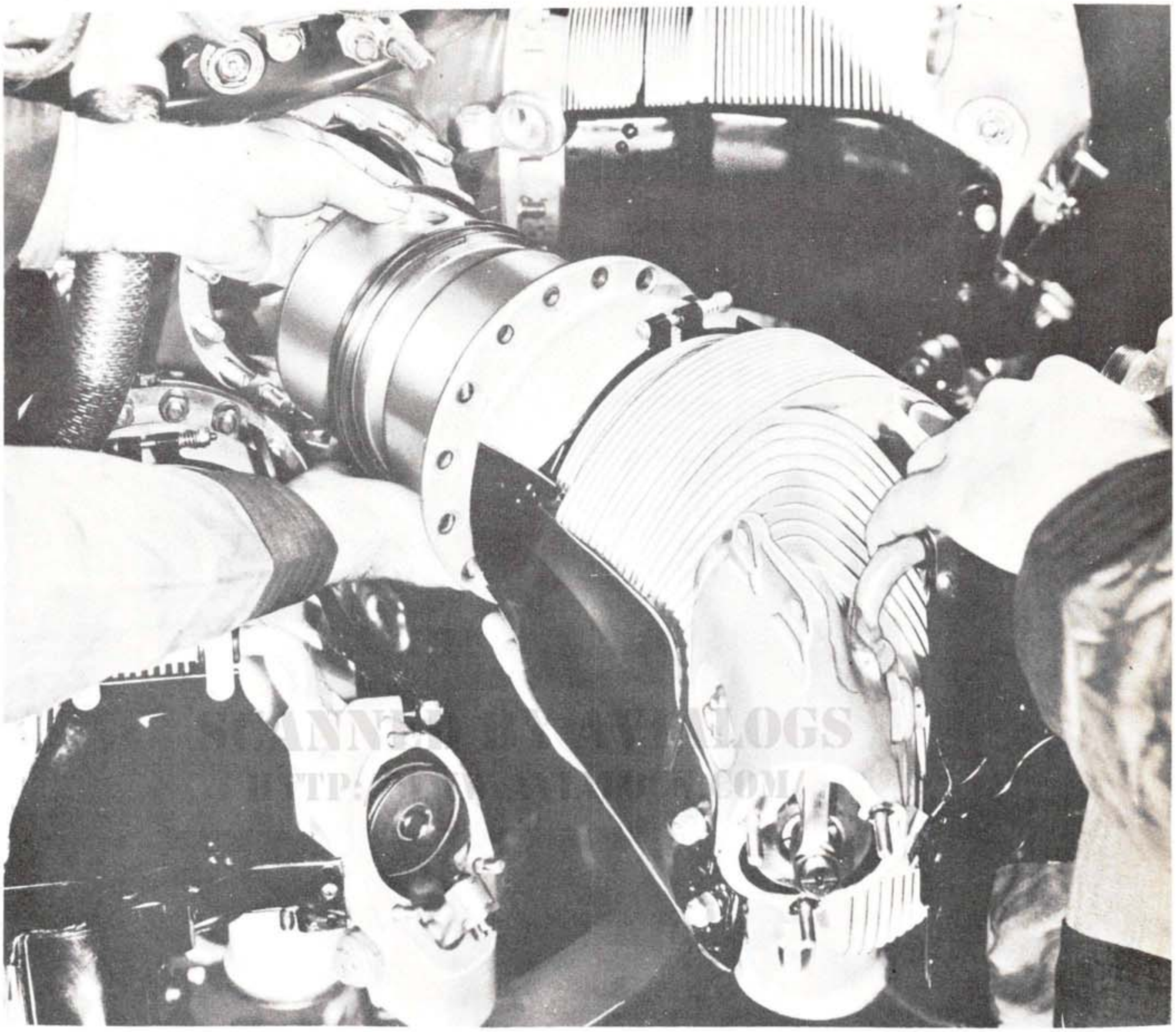


Figure 211—Removal of Cylinder

cylinder barrel so as to form a pressure tight joint. The cylinders have integral fins to provide a means of cooling, and each cylinder is provided with air deflectors which direct the air to avoid effective cooling. The cylinder head incorporates two rocker housings or rocker boxes which are cast integral with the head. Inter-ear oil drain pipes are provided between the rocker housings of the cylinders located below the horizontal centerline of the engine. These drain pipes serve to drain scavenge oil from the rocker housings and valve mechanisms to the rocker drain oil sump (see figure 210A.) The intake and exhaust valves are supported in the cylinder head with bronze intake and exhaust valve guides. The valve seats are the insert type, the intake seat being of bronze and the exhaust seat being made of steel.

(b) REMOVAL.—Top overhauling of an engine is not recommended except in case of emergency. If it becomes necessary to remove a cylinder for inspection or other purposes, the following steps contain the necessary information for the performance of this work. (See figure 211.)

1. Remove enough cowling to make the cylinder readily accessible. (See paragraph 5.*d.*, this section.)

Note

If several cylinders are to be removed, the master rod cylinder should be removed last and installed first. The master rod cylinder on the front bank of cylinders is No. 12, and the master rod cylinder on the rear bank of cylinders is No. 5.

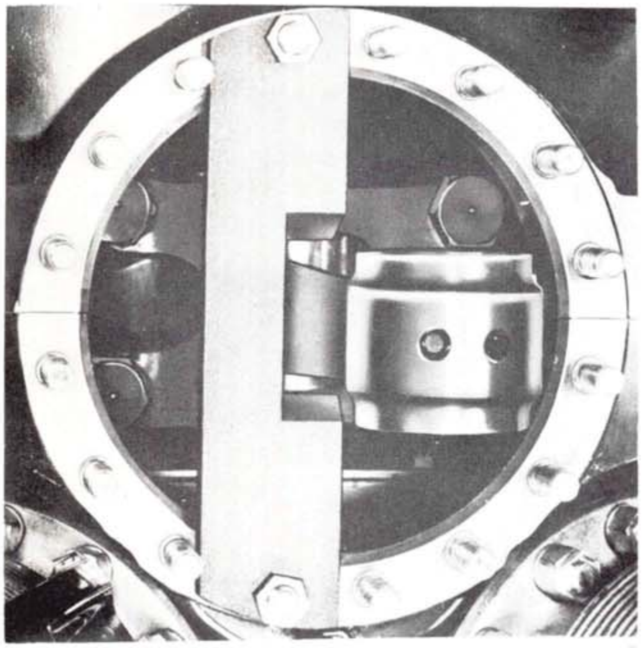


Figure 211A—Master Rod Supported in Center of Cylinder Pad

(Figure Nos. 212, 212A and 212B deleted.)

2. Remove all front spark plug lead elbows from the spark plugs and remove the front spark plugs. Remove the rear spark plug elbow and the rear spark plug from the cylinder to be removed.

3. Turn the propeller shaft until the piston of the cylinder to be removed is on top dead center of the compression stroke.

4. Remove the nuts which fasten the exhaust piping to the cylinder exhaust port. Remove the pin which is located at the first exhaust pipe joint aft of the cylinder. This loosens the pipe enough for removal of the cylinder.

5. Loosen the push rod cover gland nuts, using PWA-1424 wrench. Loosen and remove the rocker box covers.

6. Depress the valves, using PWA-455 depressor and remove the push rods and cover tubes (figure 206).

7. Remove primer lines if installed on cylinder being removed.

8. Loosen the packing nuts at each end of the intake pipe with PWA-5072 wrench, and remove the intake pipe (figure 204).

Note

The intake pipe is constructed of thin gage steel which is easily dented or damaged if not handled carefully.

9. Loosen the clamps which secure the hose connections of the inter-cylinder drain pipes and slip the hoses to one side.

10. Remove the cylinder hold-down nuts and washers. Pull the cylinder from the engine. *DO NOT* allow the piston to fall against the adjacent cylinders. Handle the cylinder carefully to prevent damage to the lower skirt of the cylinder barrel. (See figure 211.)

CAUTION

> If the master rod cylinder is to be removed, arrange to hold the master rod in the center of the crankcase opening so that it cannot turn to either side upon removal of the cylinder (figure 211A). This may also be done by rigidly blocking the master rod on each side.
>
> If the master rod is permitted to move sideways, the oil scraper rings on some of the other pistons will come out of the cylinders, resulting in a locked engine. If this occurs, further work on the engine cannot be accomplished by field equipment. In this event the engine should be removed and sent to a repair depot.

11. Cover the cylinder crankcase opening and the blower section opening to prevent the entrance of dust or any other foreign material.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Examine cylinder heads for cracks or other damage. Blend any sharp corners of broken fins before installing the cylinder.

2. Any slight unevenness or distortion of the cylinder hold-down flange may be remedied by lapping on a cylindrical lapping plate.

3. Inspect for scored barrels, worn valve seat inserts, excessive carbon deposits, damaged spark plug bushings, and worn or damaged valve guides.

4. If more than 12 inches in length of any one fin is completely broken off or if the total fin breakage on any one cylinder head exceeds 33 square inches, the cylinder must be replaced. Where adjacent fins are broken in the same area, the total permissible length of breakage is six inches on each of two adjacent fins and four inches on each of any three adjacent fins.

5. Examine all cylinder studs and hold down nuts for cracks, damaged threads or other visible defects. Clean the threads of the studs and nuts thoroughly, using a hand wire brush if desired. Remove any roughness or burrs on the nuts, studs, or cylinder flanges. (NAVY PERSONNEL: Refer to Navy General Engine Bulletin No. 55.)

(d) INSTALLATION.—Too much emphasis cannot be placed on the use of extreme care during the installation of the cylinders, and it is recommended that the following instructions be carefully observed.

1. Examine the spherical seats at the stud holes in the cylinder attaching flange and be sure they are free from burrs, aluminum spray, paint, and dirt. *Be sure* that the crankcase mounting pad is also clean.

2. Coat the cylinder walls, pistons, and rings with a generous amount of engine oil. Stagger the ring gaps around the circumference of the piston. See that the rubber cylinder oil seal ring is in place under the mounting flange.

2A. Rotate the propeller until the linkrod or master rod of the cylinder to be installed is at its full outward position. Install the rear row cylinders first. The master rod cylinder should be the first in each row to be installed. The rear master rod cylinder is No. 5 and No. 12 is the font master rod cylinder.

3. Slide the cylinder over the piston and into place against its mounting pad, being careful to see that the flange does not damage the stud threads. Use piston ring compressor PWA-489 or any other suitable ring compressor to compress piston rings.

4. Center the cylinder on its studs by installing two Pratt & Whitney PWA-3197 Cylinder Locating Nuts on two studs at opposite sides of the cylinder flange. *Do not use washers of any kind under these nuts.*

5. Tighten the locating nuts with one hand while jarring the cylinder with the other hand until they are firmly seated in the recesses of the cylinder flange. When these nuts cannot be tightened further by hand in spite of continued jarring of the cylinder, use an open-end wrench to tighten them firmly.

6. Examine the cylinder hold-down nuts and spherical washers carefully to see that they are clean and free from burrs.

7. Install the washers, flat side out, over the remaining studs. Be sure that they are seated properly and not turned sideways.

8. Install the hold-down nuts and tighten them to a torque of 325-350 inch-pounds. Remove locating nuts and install hold-down nuts and washers.

Note

> No special lubricant should be used on the threads, but the use of kerosene or engine oil is permissible. Particular attention should be given to torquing the less accessible nuts.

Back off each hold-down nut individually to 0 inch-pounds and then retighten to 300-350 inch-pounds torque. Secure all the nuts with palnuts. Do not tighten the nuts above the recommended torque. The studs may be stretched or broken if excess force is used.

9. Install the intake pipes in the following manner.

a. Install the packing and packing nut at the blower end of the intake pipe and a small rubber seal, packing, and packing nut at the cylinder end of the intake pipe after first coating the seal with a thin even coat of insulating compound (Specification No. AN-C-128).

b. Place the intake pipe in position on the engine and screw the lower packing nut loosely into the blower housing.

c. Screw the upper packing nuts on the unions of the cylinder inlet ports and tighten with PWA-5072 wrench.

d. Tighten the nuts on the blower end of the intake pipe.

10. Install the hose and tighten the clamps of the intercylinder drain pipes.

11. Install primer lines if primer is used on this cylinder.

12. Install the push rods as in paragraph 6.*b.* (2) *(d)* preceding.

13. Install exhaust pipe joint pin and tighten the exhaust piping to the cylinder.

14. Install exhaust pipe joint pin and tighten the exhaust piping to the cylinder.

15. Install cowling. (See paragraph 5.*d.*, preceding.)

(e) CYLINDER COMPRESSION TEST.—(See figure 212C.) Using Aircraft Engine Cylinder Compression Tester Assembly, Type S-1, Part No. 47R-11992, and a .040-inch orifice bleeding into the cylinder, check the cylinder compression as follows:

1. To obtain consistent readings, it is advisable to perform the compression check as soon as possible after the engine has been shut down. This is desired in order that all piston rings, etc., will be uniformly lubricated. It will not be necessary to operate the engine prior to accomplishing the compression checks during engine build-up or on individually replaced cylinders. However, in such cases, a small quantity of lubricating oil will be sprayed in the cylinders and the engine turned over a few times to seal the piston rings, etc., prior to accomplishing the compression check.

2. Take standard precautions against accidental firing of the engine.

3. Remove necessary cowling.

4. Remove the most accessible spark plug from each cylinder.

5. Install the spark plug connector and seal ring in the No. 1 cylinder (see figure 212D.) Tighten the spark plug connector sufficiently to assure a seal.

6. Connect the compression tester assembly to the compressed air supply. With the check valve closed, adjust the main line pressure from the compressor to 80 psi on the regulated pressure gage.

7. Open the check valve and attach the air hose quick-connect fitting to the spark plug connector. This will establish a pressure of 15 psi in the cylinder when both intake and exhaust valves are closed, provided the cylinder will hold 15 pounds when checked, as outlined in step 10.

8. Turn the engine over in the direction of rotation by hand, until the piston in the No. 1 cylinder is coming up on compression stroke against the 15 psi, and continue turning slowly until the piston reaches top dead center. Reaching top dead center is indicated by a flat spot or sudden decrease in force required to turn the propeller. If the engine is rotated too far, back up at least one-half revolution and start over again to eliminate the effect of backlash in the valve operating mechanism, and to keep the piston ring seated on the lower ring lands.

9. Close the shut-off valve. Check the regulated pressure and adjust, if necessary, to 80 psi.

CAUTION

Care must be exercised in closing the shut-off valve, for if the piston is not at top dead center, there will be sufficient air pressure build-up in the cylinder to rotate the propeller approximately 1/4 turn.

10. With the regulated pressure adjusted to 80 psi, if the cylinder pressure reading as indicated on the cylinder pressure gage is below the minimum of 35 psi, move the propeller in the direction of rotation to seat the piston rings in the grooves. If the pressure does not build up, go on to the next cylinder. When all cylinders have been checked and readings recorded, return to the cylinder or cylinders having low compression readings.

11. When low compression is obtained on cylinders, the engine will be turned through with the starter or restarted and run to take-off power and the cylinder or cylinders having low compression rechecked. If this does not correct the difficulty, the rocker box cover will be removed and the valve clearance checked to determine if the low pressure is due to negative valve clearance. If the difficulty is not caused by negative valve clearance, place a fiber drift on the rocker arm immediately over the valve stem, and tap the drift several times with a one-to-two-pound hammer. Then rotate the engine with the starter and recheck the compression.

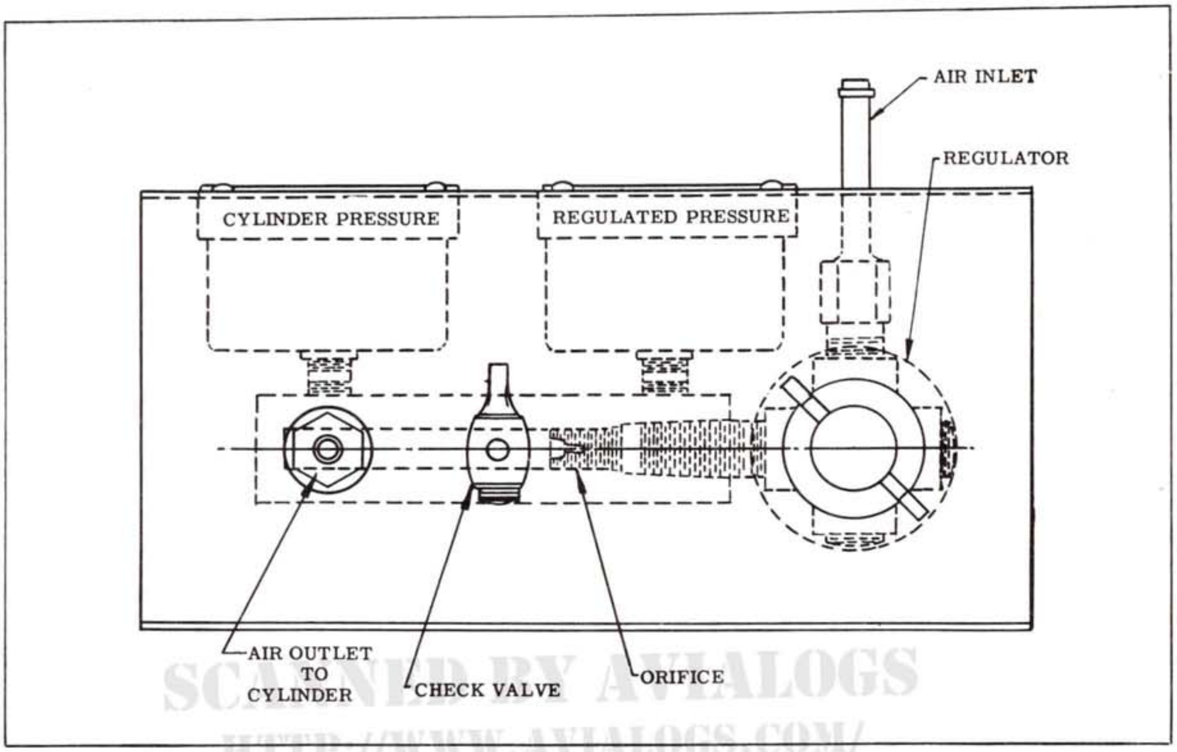

AIR INLET
REGULATOR
CYLINDER PRESSURE
REGULATED PRESSURE
AIR OUTLET TO CYLINDER
CHECK VALVE
ORIFICE

Figure 212C. Compression Testing the Cylinder

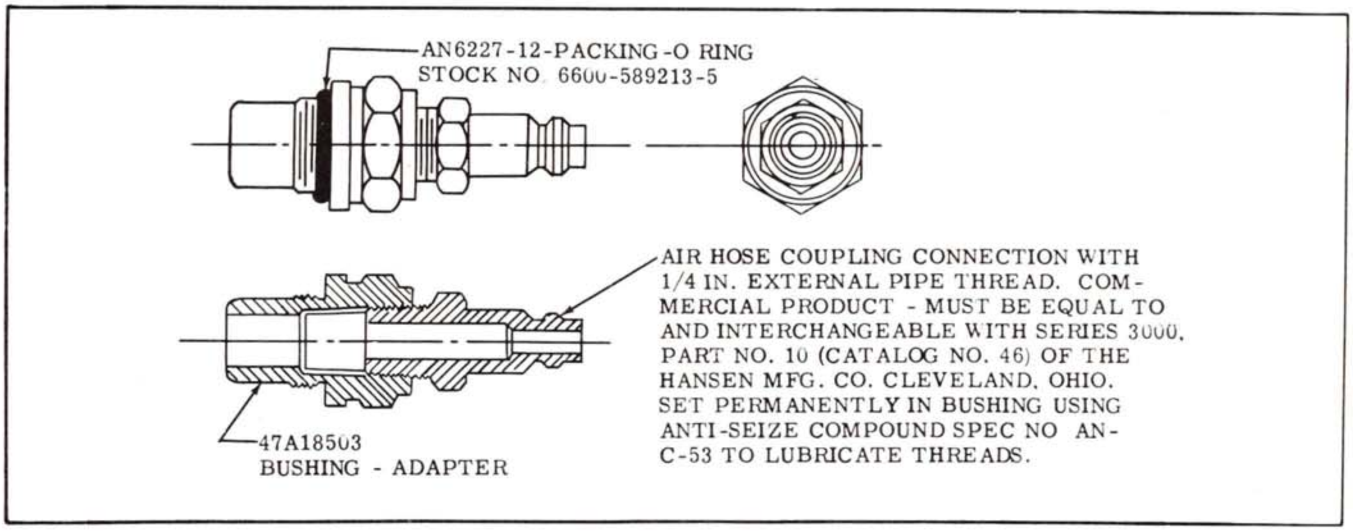

AN6227-12-PACKING-O RING
STOCK NO. 6600-589213-5
AIR HOSE COUPLING CONNECTION WITH 1/4 IN. EXTERNAL PIPE THREAD. COMMERCIAL PRODUCT - MUST BE EQUAL TO AND INTERCHANGEABLE WITH SERIES 3000, PART NO. 10 (CATALOG NO. 46) OF THE HANSEN MFG. CO. CLEVELAND, OHIO. SET PERMANENTLY IN BUSHING USING ANTI-SEIZE COMPOUND SPEC NO AN-C-53 TO LUBRICATE THREADS.
47A18503
BUSHING - ADAPTER

Figure 212D. Connector Assembly, Cylinder Compression Tester

Note

Compression checks will not be made after staking a valve, until the crankshaft has been rotated, either with the starter or by hand, to reseat the valve in a normal manner, as the higher seating velocity obtained when staking the valve will indicate valve seating, even though valve seats are slightly egged or eccentric.

12. Cylinders having low compression below the minimum 35 psi after accomplishing the foregoing action will be further checked to determine whether leakage is past exhaust valve, intake valve, or piston. Excessive leakage past the piston is the second most frequent cause of compression leakage and can be detected on cylinders approaching the horizontal position by squirting engine oil around the piston and rechecking the compression. If this action raises compression to, or above the minimum required, the cylinders may be continued in service. Results of the above tests will be entered on a compression check sheet.

13. Repeat the procedure outlined in steps 1 through 10.

14. Engines with more than four cylinders having less than the specified minimum compression value of 35 psi will be given a flight test followed by a recheck of the cylinders having the low compression. If more than four cylinders still retain less than the specified 35 psi minimum compression value after the flight test, the engine will be replaced.

(6) PISTONS.

(a) DESCRIPTION. — The pistons are machined from aluminum alloy forgings and are held within close tolerances of weight to assure proper balancing. Each piston incorporates five rings. Recesses in the head allow clearance for the heads of the inlet and exhaust valves.

Three compression rings are installed in the three top grooves. The fourth groove holds a dual oil ring; the rings being installed with the ventilated side down. The oil scraper ring is installed in the fifth groove, with the ventilated side down. The latter ring is located *below* the bore of the piston pin boss.

(b) REMOVAL.—If it becomes necessary to remove a piston, a recommended procedure is outlined following:

1. Remove the cylinder as instructed in paragraph 6*b*.(5)*(b)*, preceding.

2. Push out the piston pin by hand and remove the piston. Do not allow the piston pin to drop or become nicked.

Note

If the piston pin is difficult to remove due to accumulations of carbon, etc., the piston should be protected from contact with adjacent cylinders and the connecting rod should be braced or supported in a suitable manner. Lightly tap the piston pin out of the piston. Do not attempt to drive out piston pin without bracing or supporting the connecting rod, or damage to the knuckle pin bushings or the master rod will result.

3. After the piston is removed, cover the exposed section of the rod and crankcase opening to prevent the entrance of dust, dirt or foreign objects.

(c) (Deleted)

(d) INSTALLATION.

1. through *3* (Deleted).

4. Lubricate the piston pin with clean engine oil and insert the pin through the piston and rod bushing. This should require only a light hand push.

5. Lubricate the piston and ring assembly with a generous amount of oil and stagger piston ring gaps so that they are not in alignment. Also see that none of the ring gaps are directly over the piston pin opening of the piston.

6. Check and make sure that no foreign material has fallen into or has been left in the cylinder crankcase openings.

7. Slide the cylinder over the piston and bolt into place, using the procedure outlined in section IV, paragraph 6.*b*.(5)*(d)*, preceding.

(e) ESTABLISHING TOP DEAD CENTER.

1. Install a top center indicator, part number WAC804177, (figure 212E) either in the front or rear No. 1 cylinder spark plug hole. In installing the top center indicator, the arm will have to be adjusted as necessary so that, when the piston moves through the full stroke, full scale deflections on the indicator will be obtained.

2. Install a protractor and pointer on one arm of the engine accessory drive pads or applicable nose timing segment. (See figure 212F and 213).

3. Pull the propeller through in the direction of rotation until the cylinder is coming up on compression stroke of the applicable cylinder, which can be determined by the air pressure build up.

4. Continue pulling the propeller through in the direction of rotation until the piston contacts the arm of the top center indicator and moves the indicating arm of the indicator to any one of the marks on the indicator. This mark will be recorded for future reference.

5. With the piston stopped in the reference position, record the protractor readings in degrees, or set the pointer assembly for the protractor to specify any desired number of degrees. In either case, record the protractor reading.

6. Move the propeller slowly on in the direction of rotation until the top center indicates that the

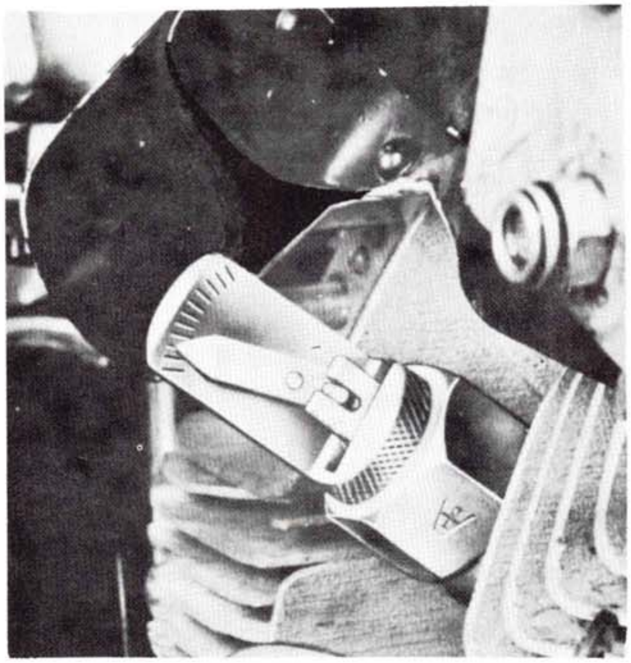


Figure 212E. Installing Top Center Indicator

piston has moved to the top of the stroke and is moving back down again. When top center indicator indicates the same identical position as was selected previously on the up stroke, rotation of the propeller will be stopped.

7. Again read and record the protractor reading in degrees. Top dead center will be halfway between the degrees recorded. Reset the pointer to zero for ignition timing.

8. After true top dead center has been established, it should be rechecked prior to making any adjustments on valves or ignition system, since slippage of the adjustable arm of the top center indicator or binding of the pointer on the protractor could cause an error in the reading obtained. Prior to adjusting ignition timing or valves it is essential to establish the ratio of pointer travel to crankshaft travel, since use of the wrong protractor or failure to establish this ration may result in improper adjustment.

(7) VALVES.

(a) DESCRIPTION.—Each cylinder contains an inlet and an exhaust valve. A steel insert in the valve adjusting screw (installed in the rocker arm) is used as a contact between the adjusting screw and the valve stem to minimize the friction at this point. Exhaust valves

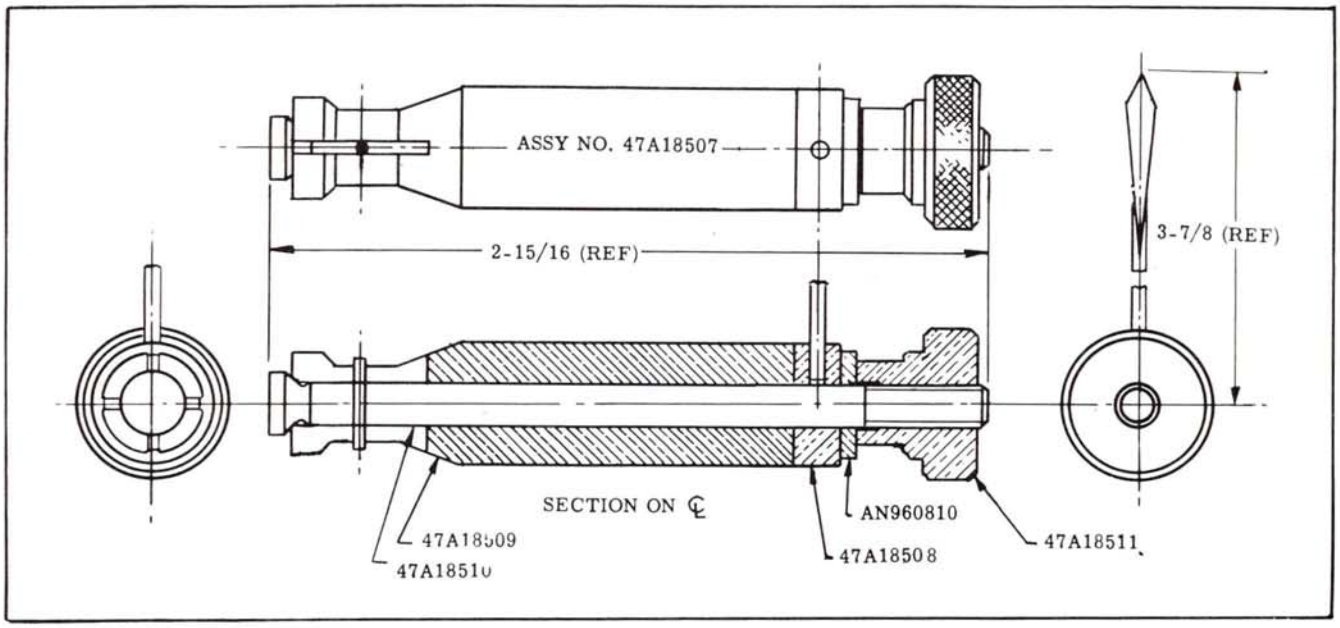
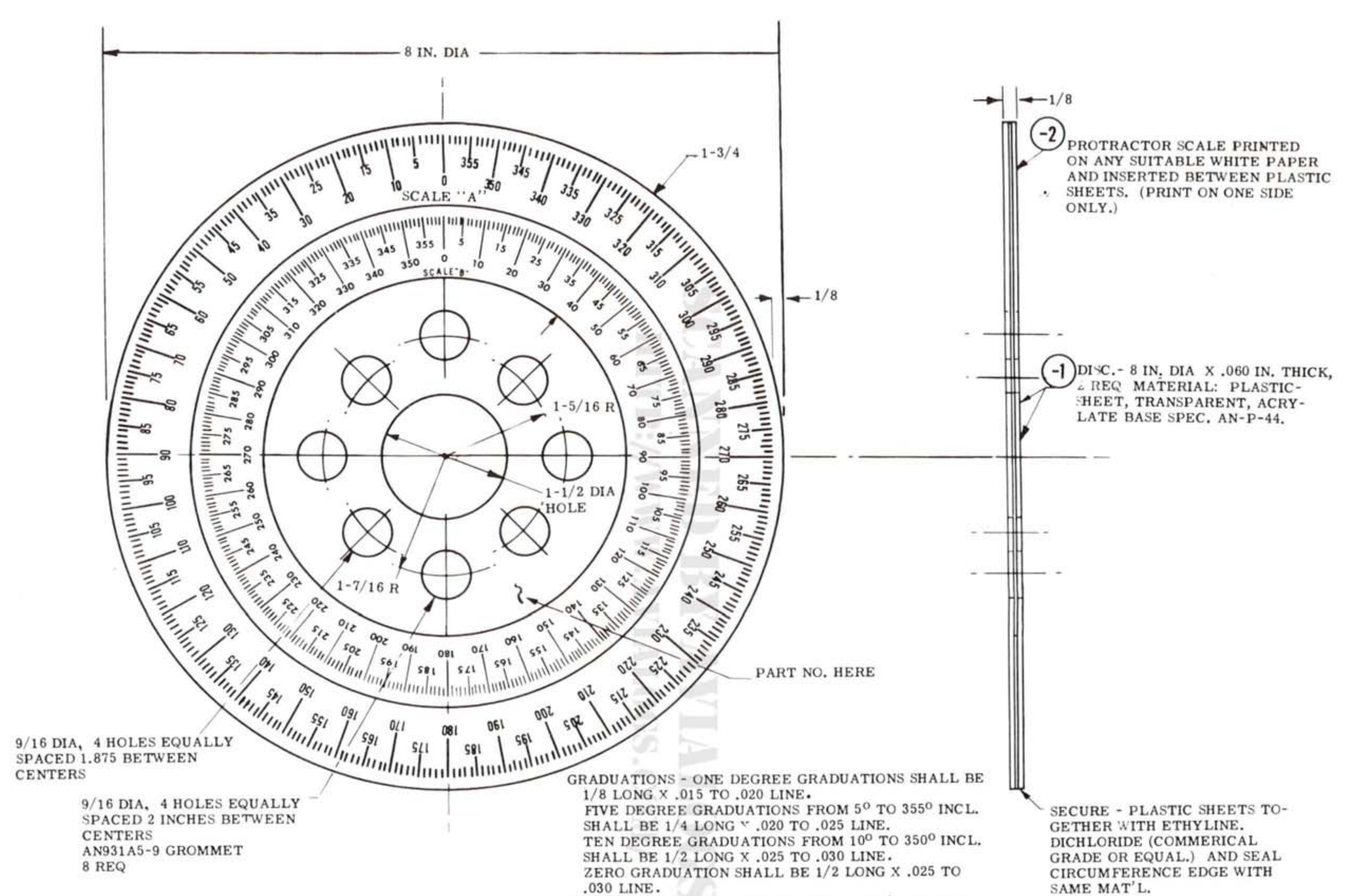


Figure 212F. Pointer Assembly, Engine Timing Disc



9/16 DIA, 4 HOLES EQUALLY SPACED 1.875 BETWEEN CENTERS

9/16 DIA, 4 HOLES EQUALLY SPACED 2 INCHES BETWEEN CENTERS
AN931A5-9 GROMMET
8 REQ

-2 PROTRACTOR SCALE PRINTED ON ANY SUITABLE WHITE PAPER AND INSERTED BETWEEN PLASTIC SHEETS. (PRINT ON ONE SIDE ONLY.)

-1 DISC.- 8 IN. DIA X .060 IN. THICK, 2 REQ MATERIAL: PLASTIC-SHEET, TRANSPARENT, ACRYLATE BASE SPEC. AN-P-44.

SECURE - PLASTIC SHEETS TOGETHER WITH ETHYLINE. DICHLORIDE (COMMERICAL GRADE OR EQUAL.) AND SEAL CIRCUMFERENCE EDGE WITH SAME MAT'L.

GRADUATIONS - ONE DEGREE GRADUATIONS SHALL BE 1/8 LONG X .015 TO .020 LINE.
FIVE DEGREE GRADUATIONS FROM 5° TO 355° INCL. SHALL BE 1/4 LONG X .020 TO .025 LINE.
TEN DEGREE GRADUATIONS FROM 10° TO 350° INCL. SHALL BE 1/2 LONG X .025 TO .030 LINE.
ZERO GRADUATION SHALL BE 1/2 LONG X .025 TO .030 LINE.
NUMERALS - ALL NUMERALS SHALL BE 5/32 HIGH X .025 TO .030 LINE.
ALL GRADUATIONS MUST BE ACCURATELY SPACED WITHIN ± 0° - 15'.
COLOR OF PROTRACTOR SCALE AND NUMERALS TO BE BLACK ON WHITE BACKGROUND.

Figure 213. Engine Timing Disc, Compression Tester

have hollow heads and stems and are sodium filled. Inlet and exhaust valve springs are interchangeable and the springs can be removed without taking the rockers out. After the push rod has been removed, the rocker arm can be tipped up far enough to permit removal of the spring.

(b) REMOVAL AND DISASSEMBLY.— This operation must be done with the cylinder removed from the engine.

1. Place the cylinder over a wooden block which has the same contour as the inside of the cylinder head.

2. Compress valve springs with the valve spring depressor PWA-455 (figure 206). Remove split locks which hold the outer valve spring washer in place (figure 207).

3. Lift out valve springs and washers.

4. Remove the cylinder from the block, taking care not to drop valves if safety circlets are not installed.

5. Remove safety circlets from the valve, if installed, and lift the valves out. *DO NOT* allow the valves to fall out and strike the cylinder wall.

6. Place the valves in a rack or protect them otherwise to insure correct assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Check the exhaust valves with the valve radius stretch gage (figure 208) by holding the edge of the gage against the stem of the valve, and the curvature of the gage against the radius of the valve head. A clearance of 1/32 inch or more between the gage and the valve is cause for replacment.

2. Valves which have creases, or show signs of swelling or drawing where the head joins the stem, must be replaced.

CAUTION

To prevent possible injury to personnel, unserviceable sodium-filled exhaust valves should be disposed of carefully. Air Force personnel: refer to T.O. No. 02-1-67: Navy Personnel: refer to General Engine Bulletin No. 8.

3. Inspect the lock and lock grooves for wear, galling, or burns. Check the fit of each pair of locks with its valve. A lock and valve should have no perceptible movement when it is in place, and the radii of the lock and valve should coincide.

4. Inspect the valve heads for excessive pitting or erosion.

5. Examine the valve springs for cracks, rust, pit marks, broken ends, inadequate pressure and improper length.

(d) ASSEMBLY AND INSTALLATION.—This procedure must be done with the cylinders removed from the engine.

1. Clean and oil the valve stems and guides before installing them in the cylinders.

2. Place each valve in position and, if so equipped, install the safety circlets. Place the cylinder over a dome-headed wooden block to hold the valves in place during assembly of the valve springs.

3. Place the lower valve spring washer, the inner and outer valve springs, and the upper valve spring washer in position. Compress the valve springs with the valve spring depressor (figure 206) and install the split cone locks (figure 207) which hold the valve, springs, and washers in place. (Refer to paragraph 6.*b.* (4) *(e)* for adjustment of valves.

(8) BLOWER DRAIN VALVE
(figures 213A and 213B).

(a) DESCRIPTION.—The blower drain valve is located on the bottom of the intermediate rear crankcase of the engine (figure 213A). It is connected with a line leading away from the blower case to a point outside the cowling, near the lower forward edge of the firewall. The function of the blower drain valve is to prevent an accumulation of fuel in the lower part of the blower case, which might otherwise run into the lower cylinders and cause damage to the engine when it is started.

This valve consists of a plate which floats on a shaft and seats against a circular lip on the inside of the adapter. When gasoline accumulates in the valve adapter, the valve allows the gasoline to drain out. When the engine is started, the pressure accumulated by the blower holds the valve closed.

(b) REMOVAL.—In severe cases of engine backfire, the blower drain valve assembly is sometimes damaged, which will necessitate removal of the drain valve.

1. Remove the lower sections of the engine accessory cowling.

2. Remove hose clamps and slip hose to one side.

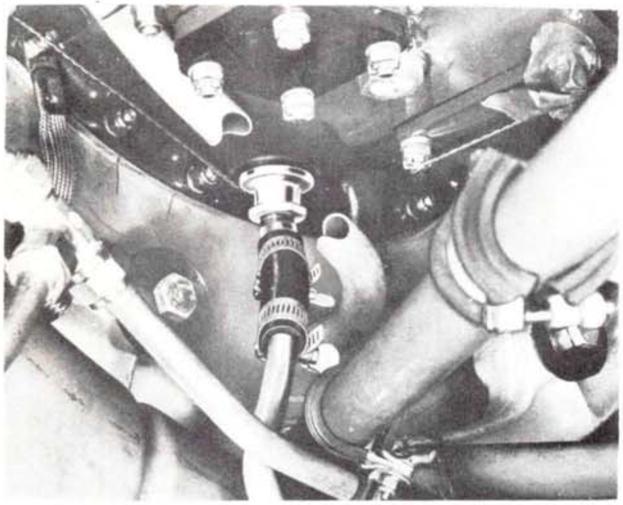


Figure 213A—Blower Drain Valve Installed

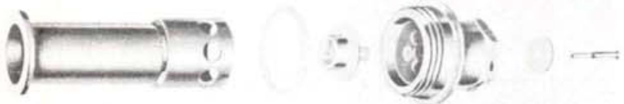


Figure 213B—Exploded View of Blower Drain Valve

3. Remove the drain valve, using a wrench of the proper size. (On some installations it first may be necessary to remove the hose elbow.)

(c) INSPECTION AND REPAIR. — In some cases, engines have been damaged by failure of personnel to ascertain definitely that this valve was functioning properly after removing the engines from storage or after operation in extremely dusty conditions. The small hole through the center of the shaft must be clear and free of sand, dust particles, or any other form of foreign substance.

The operation of the blower drain valve may be checked by the following procedure: Using a piece of hose or the bare tube end itself, below into the blower drain line. If, after a few seconds of blowing, there is a sudden stoppage or restriction in the air passage, the blower drain valve is operating. If the valve is stuck open, there will be no automatic closing of the valve, as indicated by the results of the above procedure. If the valve is stuck closed, pressure will be built up immediately in the line and prevent further blowing in the line. If the drain valve is stuck in either position, it should be removed and cleaned. The fuel booster pump should not be used to check the operation of the valve.

(d) INSTALLATION.

1. Install gasket and valve (figure 213B).

2. Install hose and hose clamps.

3. Replace the engine accessory cowling.

(9) SUPERCHARGERS, C-47, C-47A, and C-47-D. —R-1830-92 engines in C-47 and C-47A airplanes and R-1830-90D engines in C-47D airplanes are equipped with integral single-speed superchargers with an impeller gear ratio of 7.15 to 1.

(10) SUPERCHARGERS, C-47B.—R-1830-90C engines in C-47B airplanes have single-stage, two-speed superchargers with a low blower ratio of 7.15 to 1, and a high blower ratio of 8.47 to 1. The low gear ratio allows the engine to operate efficiently at sea level and low altitudes. The high gear ratio allows the engine to maintain higher power at greater altitudes than would be possible with only the low ratio.

The control for high and low blower is located to the left of the pilot. When the control is moved from one position to the other, hydraulic pressure actuates a strut which positions the lever of the engine selector valve. This selector valve is located on the upper left hand side of the intermediate rear crankcase of the engine (figure 213C). The valve then directs engine oil pressure into passages in the crankcase housing leading to the high or low blower clutches.

At the same time the hydraulic actuating strut moves or positions the engine selector valve into "HIGH" blower, it also actuates a micro-switch. This is connected into an electrical indicating system, with the indicator lights being located on the blower control panel. These lights, one for each engine, will go on when the blower clutch selector valve is in "HIGH" position; in "LOW" position they will go out. Failure of one or both of these lights to function when the blower control is in "HIGH" position is a warning that the control system may not be functioning properly.

(a) (Deleted)

(b) BLOWER CLUTCH SELECTOR VALVE *(figure 213C).*

1. DESCRIPTION.—The selector valve housing is a machine finished, anodized, magnesium alloy

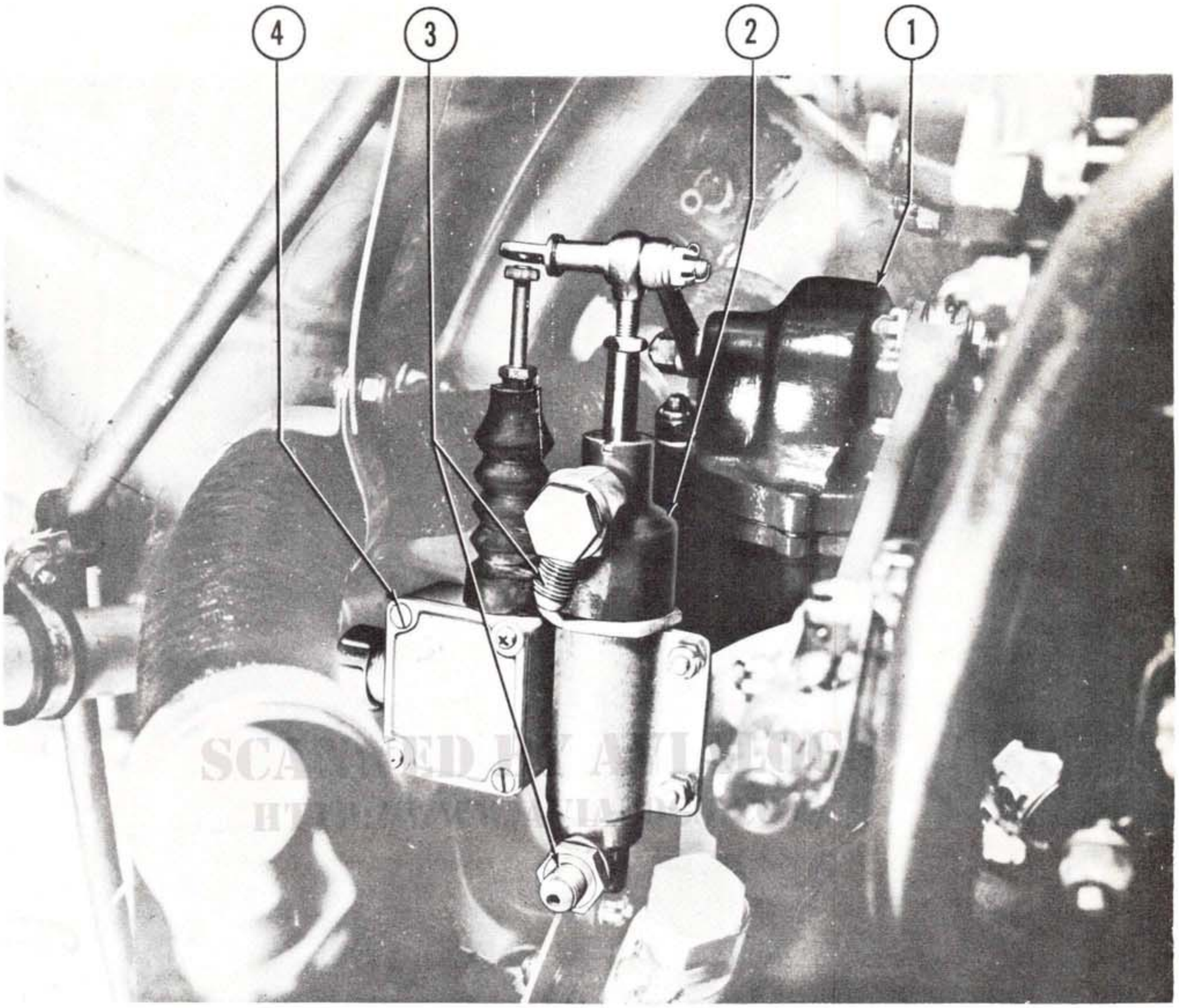


Figure 213C—Blower Selector Valve Actuating Cylinder and Indicator Switch Installed

1. Blower Clutch Selector Valve
2. Hydraulic Actuating Cylinder
3. Hydraulic Connections
4. Selector Valve Indicator Switch

casting designed to house the selector valve and linkage required for directing pressure oil to the high and low ratio clutches. This assembly is mounted on the left side of the intermediate rear crankcase of the engine adjacent to the carburetor mounting pad and is attached with four 5/16 inch-24 studs, flat washers and insert nuts. Pressure oil passages are provided in the selector valve housing, the selector valve housing bore in the crankcase, and in the intermediate rear crankcase.

2. REMOVAL FOR FLUSHING CLUTCHES.

a. Disconnect the hydraulic actuating strut (figure 213C).

b. Remove fiber insert nuts and flat washers on cover of housing and lift the housing and cover straight up.

3. ASSEMBLY.—After removing the flushing valve, install the selector valve and fasten securely with the fiber insert nuts and flat washers. Connect the hydraulic actuating strut and the valve will be ready for use.

(c) BLOWER CLUTCHES.

1. DESCRIPTION.—The high and low ratio clutches are separate shafts. These are driven by the main accessory drive gear through pinions splined on each of the shafts, these being in mesh at all times.

The clutches are actuated by engine oil pressure. This pressure must be great enough to over-ride the pressure of spring which holds the clutch surfaces apart. The selector valve directs engine oil pressure to

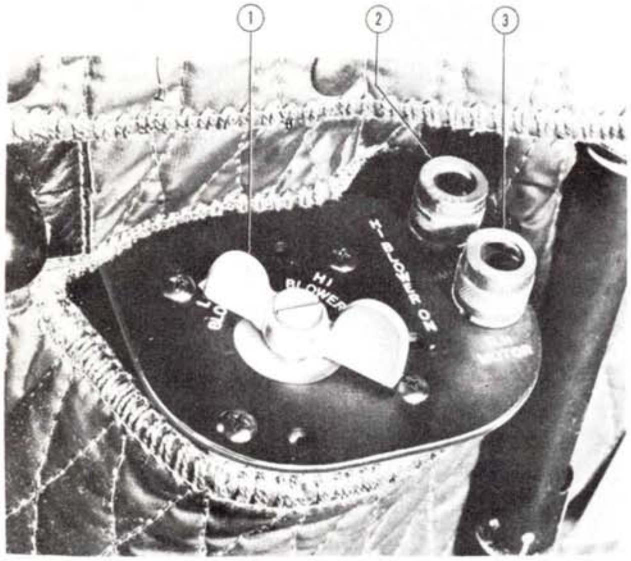


Figure 213D—Blower Control Valve and Indicator Lights

1. Blower Ratio Control
2. Indicator Light for Left Engine
3. Indicator Light for Right Engine

an oil chamber between the driving and driven cones of the clutch for the particular gear ratio selected.

Note

> Set the blower ratio selector valve in the "LOW" position for all ground operations, except when it is expressly desired to check the selector valve for proper positioning or functioning, or the supercharger drive mechanism in general for proper operation.

2. REMOVAL.—It is necessary to remove the entire rear crankcase in order to remove the clutches. This is a major overhaul job and should not be attempted as a field operation.

3. MAINTENANCE.—Clutches of this type should be shifted frequently as noted in 3.a.*(8)*, following, to avoid sludging and consequent sticking. For efficient clutch operation it is also very important that the oil be kept as clean as possible and that oils of different characteristics are not mixed in the engine.

If these precautions are taken, clutches should operate properly without becoming sludged or stuck. A periodic flushing of the clutches will provide added assurance of efficient operation. Following are instructions for shifting, periodic flushing, and freeing stuck clutches without removing the engine from the airplane.

a. SHIFTING PROCEDURE.

(1) At ground check, run the engine until the oil reaches a temperature of 40°C (104°F) or above.

(2) Set the propeller in low pitch (high rpm) position.

(3) Increase the engine speed to 1200 or 1400 rpm or to a sufficiently high speed to obtain more than the minimum oil pressure required for clutch operation (45 lb/sq in).

(4) Shift the selector valve to "HIGH" position. This operation should be accompanied by a momentary drop in oil pressure, and an increase in manifold pressure.

(5) Open the throttle to obtain a manifold pressure slightly below that prescribed for cruising in "HIGH" blower ratio, with the engine running ***at not more than 2000 rpm.***

(6) Lock the throttle and immediately shift back into "LOW" ratio position. A drop in manifold pressure and a momentary fluctuation of oil pressure will accompany the shift from "HIGH" to "LOW," a positive indication that the control system is functioning properly.

Note

> To avoid slipping the clutches, shifting should be done without hesitation between the control steps.

(7) Check the controls to be sure the blower is in low ratio to prevent inadvertent take-off in high ratio.

(8) If the shifting does not appear to be satisfactory, operate the engine at 800 to 1000 rpm or less for at least two minutes. This will dissipate the heat generated in the clutches during shifting. The shifting procedure may then be repeated.

(9) Prolonged fluctuation or loss of manifold pressure after the shift from low to high indicates improper high clutch engagement. If this occurs, return the selector valve to the "LOW" position and repeat the shifting routine. When the ground test is completed,

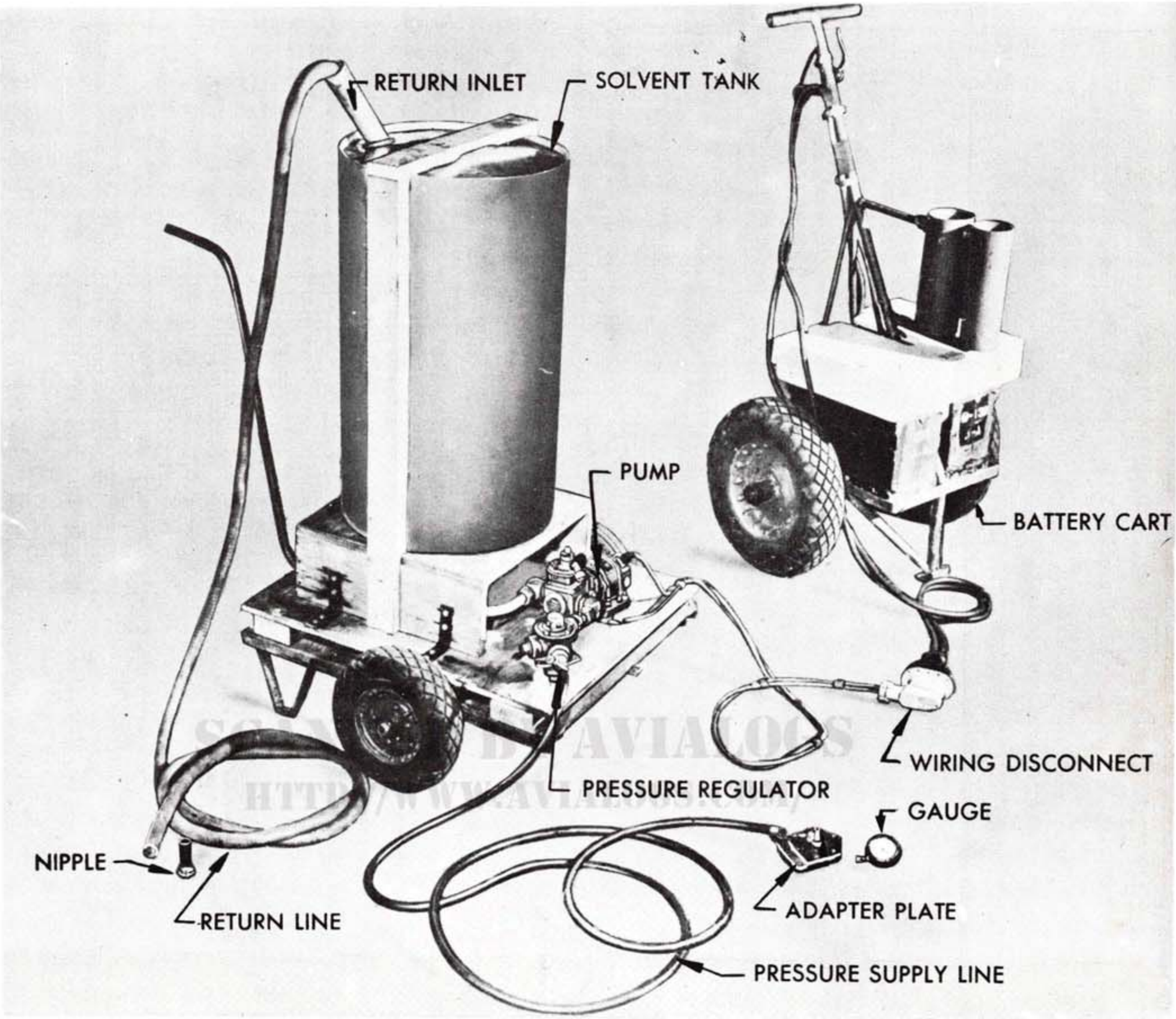

RETURN INLET
SOLVENT TANK
PUMP
BATTERY CART
WIRING DISCONNECT
PRESSURE REGULATOR
GAUGE
NIPPLE
RETURN LINE
ADAPTER PLATE
PRESSURE SUPPLY LINE

Figure 213E—Complete Equipment for Desludging Blower Clutches

check and double check the selector valve control to be sure it is in "LOW" ratio.

Note

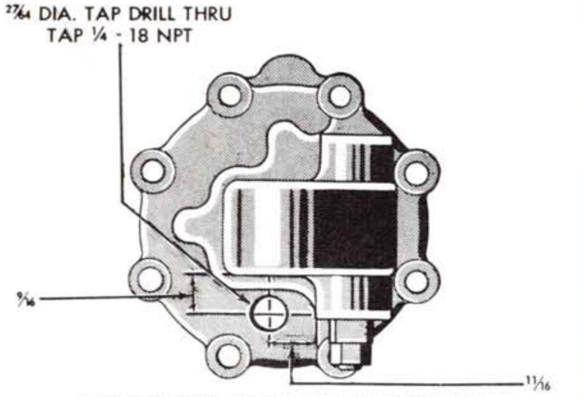
> If the airplane is being operated with the blower controls continuously in one position, shift the blower controls to the other position (either "HIGH" or "LOW") for a period of ten minutes at two-hour intervals to wash away any sludge accumulated in the blower clutches.

b. FLUSHING PROCEDURE.—Flush with cleaning solvent, Specification No. PS-661, or kerosene, Specification No. VV-K-211.

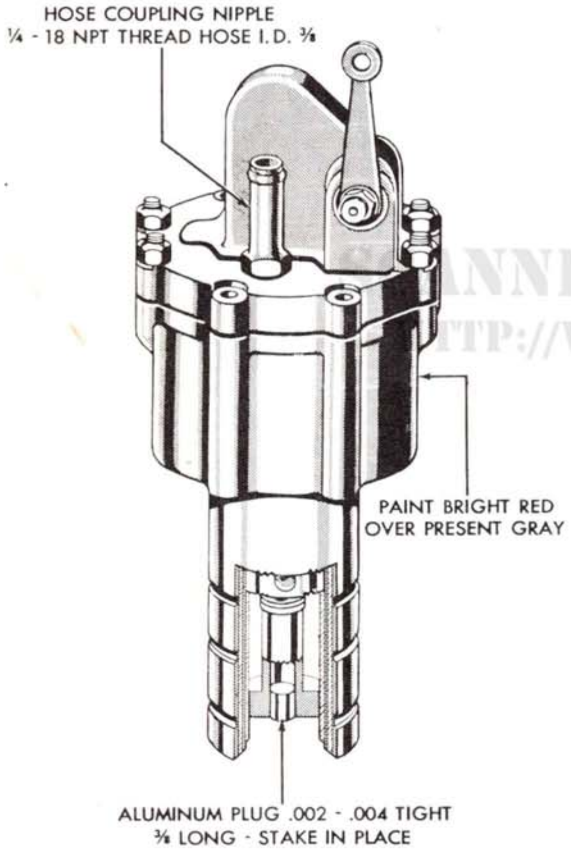
The equipment needed for flushing the blower clutches can be made from odd pieces of material available at repair shops of sufficient size to undertake this type of servicing.

The flushing equipment required (figure 213E) consists of a 20-gallon tank with a standpipe outlet in the bottom and an inlet at the top, an electrical receptacle, wiring to connect the battery cart to the pump, some sort of a mounting base (preferably on wheels), an electrically driven vane-type pump or equivalent, a pressure regulator valve, two hoses of sufficient length, a special flushing selector valve, and a special hose nipple (figure 213F).

When ready to flush the clutches, follow this procedure in sequence:



REOPERATION OF SELECTOR VALVE COVER


HOSE COUPLING NIPPLE
1/4 - 18 NPT THREAD HOSE I.D. 3/8
PAINT BRIGHT RED
OVER PRESENT GRAY
ALUMINUM PLUG .002 - .004 TIGHT
3/8 LONG - STAKE IN PLACE

PRATT & WHITNEY NO. 40173
CLUTCH SELECTOR VALVE REOPERATED FOR
USE AS CLUTCH FLUSHING VALVE

Figure 213F—Conversion of Pratt & Whitney No. 40173 Selector Valve for Use as a Flushing Valve

(1) Remove the selector valve from the engine, paragraph 6.*b*.(10)*(b)*2.

(2) Install the flushing valve using the same procedure as that for installing the selector valve, paragraph 6.*b*.(10)*(b)*3.

(3) Remove the finger drain plug from the rear cover case so that the fluid may drain out. Install the special hose nipple in the opening.

(4) Install the pressure gage on the inlet line.

(5) Connect the supply line from the pump to the flushing valve, and connect the return hose from the top of the supply tank to the adapter nipple at the location of the finger drain plug.

(6) Fill the tank with about 20 gallons of solvent, Federal Specification No. P-S-661.

(7) Set the pressure regulator for 50 pounds maximum.

(8) Place the flushing valve selector arm down or in the "LOW" blower position.

(9) Place the equipment in operation and allow the solvent to circulate through the clutch for approximately 30 minutes. Watch the gage so that pressure will not exceed 50 lb/sq in. at any time.

higher pressure.

(10) During this flushing operation, rotate the propeller approximately 120° every 10 minutes.

(11) After the low ratio clutch has been flushed, raise the control lever on the flushing valve so that it is in "HIGH" position.

(12) Place the equipment in operation and flush the high ratio clutch for approximately 30 minutes. The position of the pressure gage need not be changed for this second operation.

(13) Remove the special equipment and reinstall the disassembled parts of the engine.

(14) Start the engine and run it at 800 rpm until the minimum allowable heat temperatures are obtained 40°C (104°F).

(15) While the oil is still relatively cool, increase the engine speed to 1800 rpm.

(16) Rapidly shift the blower into high ratio. There should be a momentary drop in the oil pressure, and an increase in manifold pressure.

(17) After one or two more shifts at this rpm, allow the engine to idle in low blower to cool the clutches.

(18) Remove flushing equipment and install selector valve.

(11) ENGINE OIL SYSTEM.

(a) MAIN OIL PUMP.

1. DESCRIPTION. — The main oil pump is located on the lower left side of the engine rear section and includes one pressure section and two scavenge sections. Oil inlet and outlet ports are located in the same position.

2. REMOVAL.

a. Remove the nuts and washers holding the main oil pump to the rear section.

b. Remove the fuel pump adapter and coupling.

c. Withdraw the pump from the rear section.

3. INSTALLATION.

a. Mount the pump base and insert the two long bolts through the pump section.

b. Install and tighten the nuts to the ends of the through studs.

(b) OIL STRAINER.

1. DESCRIPTION.—Oil is forced from the pressure side of the main oil pump to the oil screen chamber through a cored passage in the engine rear section. (See 19, figure 214.) The oil strainer chamber is located at the lower right side of the rear section and contains two screens (11, figure 214), one within the other. Oil within these screens is forced through a spring-loaded check valve (12, figure 214) located at the top of the screen assembly. The check valve may be opened with a pressure of 3 to 4 pounds.

2. REMOVAL.

a. Remove the four elastic stop nuts which hold the strainer cover in place.

b. Lower the cover and the screen carefully. Do not permit it to drop out.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Examine screen for being out of shape, splits in the solder joints, or other damage.

b. It is advisable to install a new oil screen cover gasket each time the cover is removed.

c. Be sure that the inside of the sediment chamber is thoroughly cleaned.

4. INSTALLATION.

a. Replace the oil screen assembly into the strainer chamber. Insert the screen with the oil-seal ring end in first. This ring is located on the top shoulder of the screen.

b. Place the retaining spring at the bottom of the screen.

c. Install the screen cover and screw the elastic stop nuts in place.

d. Three corners of the cover are rounded and one is cut square. Install the square corner pointing toward the center of the engine.

Note

Position the screen in place in the top of the chamber. After the screen is in this position, do not permit it to slip down or out of place.

(c) OIL STRAINER BYPASS VALVE.

1. DESCRIPTION. — A bypass valve (14, figure 214) is located on the right side of the engine rear section on the side of the oil strainer chamber through which oil may flow if the strainer becomes clogged. The valve is spring-loaded to 7 to 8 pounds.

2. REMOVAL.

a. Unscrew the oil strainer bypass valve from the oil strainer chamber.

b. Remove the gasket, the spring cap gasket, and the plunger in that order.

(d) OIL THERMOSTAT.

1. DESCRIPTION. — After passing through the strainer or the strainer bypass valve, oil is routed to the thermostat (6, figure 214) located in the center of the rear section. The bimetallic thermostat is closed during cold operation, but opens when the oil temperature reaches 40°C (104°F) and causes the oil to pass into the cylinder of the oil-pressure relief valve as described below.

2. INSTALLATION.—Place the lead gasket in the recess and install the thermostatic unit, the rubber oil seal, and sealing plug. This plug is drilled to permit tightening.

(e) OIL PRESSURE RELIEF VALVE. — Two types of oil pressure relief valves are to be found on C-47 type airplanes. Generally all C-47 and C-47A airplanes are equipped with a compensating type relief valve. This type is also found on some C-47B airplanes, but the majority of these are equipped with a non-compensating type. Both types are covered in the text immediately following.

1. COMPENSATING TYPE.
(See figure 214A.)

a. DESCRIPTION.—The oil-pressure relief valve (1, figure 214) is held in the closed position by the pressure relief spring (4, figure 214) and the spring-loaded temperature compensating piston (2, figure 214). When the oil temperature is lower than 40°C (104°F), both springs hold the pressure relief valve closed against an oil pressure of approximately 400 lb/sq in. When oil temperature reaches 40°C (104°F) the oil thermostat (6, figure 214) opens and oil is admitted into the pressure relief valve cylinder. This oil raises the compensating piston, thus compressing the compensating piston spring. When the piston is raised from the shoulder on the relief valve stem, only the relief valve spring holds the valve closed. Since the normal operating temperature of engine oil is 40°C (104°F) the compensating piston is normally raised and the relief valve will open at 90 lb/sq in. When the relief valve is unseated, oil is returned to the engine oil system between the oil inlet port and the main oil pump. Three operational characteristics are performed by this combination of pressure-temperature relief valves.

(1) Cold oil at engine start often reaches a momentary pressure of approximately 300 lb/sq in. Since both the pressure relief spring and the temperature compensating spring are holding the relief valve

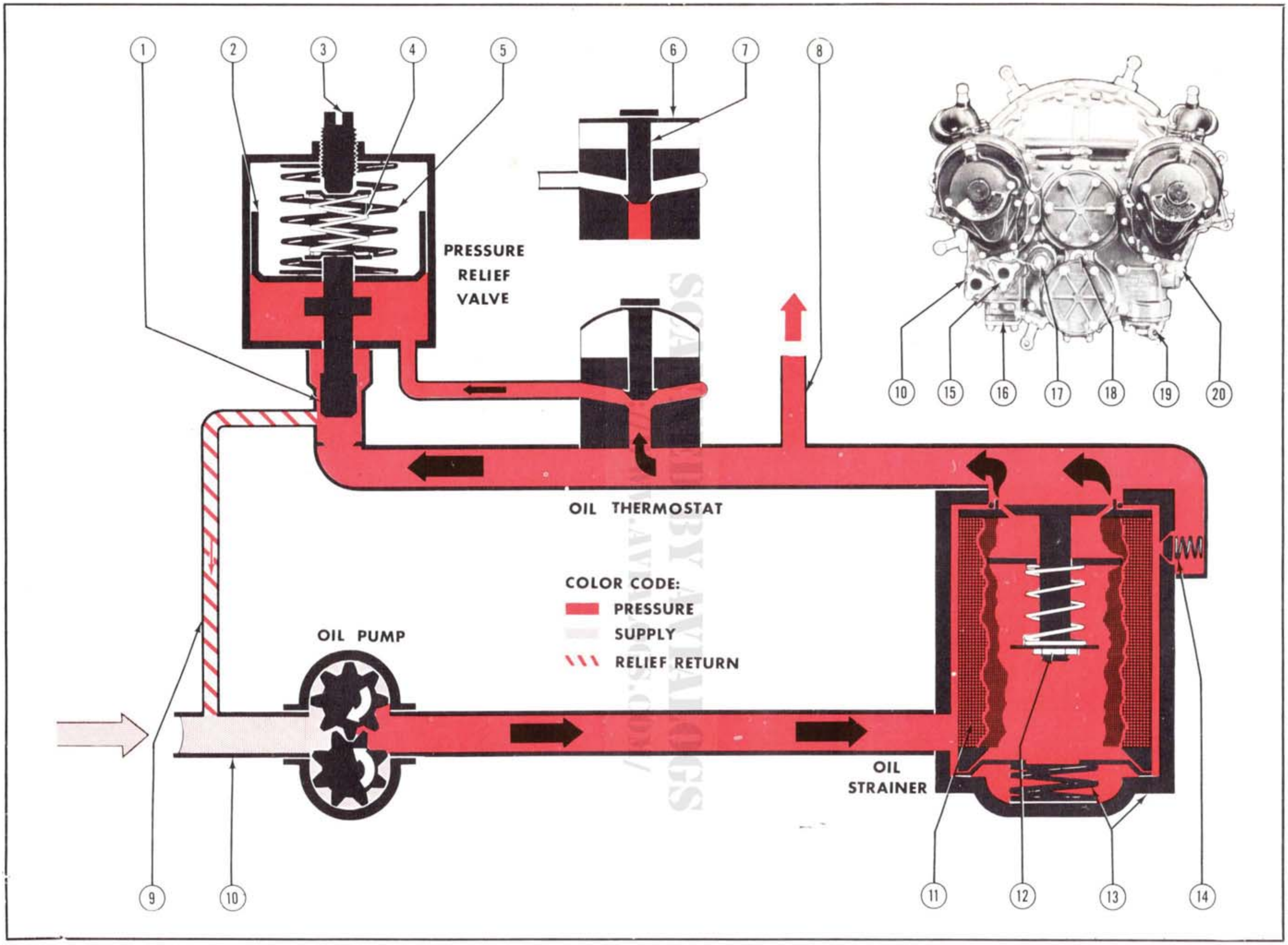

1
2
3
4
5
6
7
8
PRESSURE RELIEF VALVE
10
15
16
17
18
19
20
OIL THERMOSTAT
COLOR CODE:
PRESSURE
SUPPLY
RELIEF RETURN
OIL PUMP
OIL STRAINER
9
10
11
12
13
14

Figure 214—Schematic Diagram of Engine Oil Pressure Relief System

KEY TO FIGURE 214

1. Pressure Relief Valve
2. Temperature Compensating Piston
3. Pressure Relief Adjustment Screw
4. Pressure Relief Spring
5. Temperature Compensating Piston Spring
6. Thermostat
7. Thermostat Needle Valve
8. Pressure Oil to Engine Parts
9. Relief Return Oil (to Inlet Port) ←
10. Oil Inlet Port
11. Oil Strainer Screens
12. Oil Return Check Valve
13. Oil Strainer Chamber Cover and Spring
14. Oil Strainer Bypass Valve
15. Oil Outlet Port ←
16. Oil-Pressure Pump
17. Oil-Pressure Relief Valve and Temperature Compensating Piston
18. Oil Thermostat
19. Oil Strainer Chamber
20. Oil Strainer Bypass Valve

closed to any pressure less than approximately 400 lb/sq in., oil is forced through the engine, thus speeding up the attainment of normal operating temperature.

(2) When oil reaches the normal operating temperature of 40°C (104°F) the thermostatic needle valve is opened and the temperature compensating piston is raised.

(3) When the condition in the preceding paragraph *(2)* is attained, only the pressure relief valve spring holds the pressure relief valve closed. Therefore, any pressure above the normal operating pressure of 90 lb/sq in. unseats the valve and lowers the oil pressure. An adjustment screw (3, figure 214) is installed which permits the tension of the relief valve spring to be regulated. This adjustment is to be made during the first ground run-in operations of a new engine and is not to be changed after that time. Do not change the adjustment to remedy low- or high-pressure oil trouble.

b. REMOVAL AND DISASSEMBLY. – The compensating oil pressure relief valve assembly is located on the left side of the rear crankcase (17, figure 214).

(1) Remove safety wire from base of valve housing.

(2) Remove valve assembly, using Pratt & Whitney wrench No. PWA-1541.

(3) Remove compensating relief valve plunger from the valve body which is screwed into the rear crankcase.

(4) Remove the valve body from the rear crankcase, using wrench No. PWA-1604.

(5) Remove cover from the relief valve housing, using wrench PWA-977 for holding the cover, and wrench PWA-1604 for holding the housing (19 and 6, figure 214A).

Note

Use care in removing the cover from the relief valve housing, as this cover is under spring pressure.

(6) After cover has been removed, take out the compensating relief valve spring with inner spring guide; remove also the compensating relief valve piston spring (14, 11, and 16, figure 214A).

(7) Remove the piston assembly and the piston stem (10 and 8, figure 214A).

(8) Remove the compensating relief valve cap which houses the adjusting screw and lock nut (15, figure 214A).

c. MAINTENANCE REPAIR OR REPLACEMENT.

(1) Examine all parts for wear, especially relief valve body valve seat and the plunger seat. Examine piston stem for wear. Replace any of these parts that are worn excessively.

(2) Check springs for proper tension.

(3) Remove sharp edges from outer edges of piston stem bore in housing by stoning and/or with a round, small file. Sharp edges should also be removed from outer edges of piston and drilled holes in both ends of piston stem.

(4) Check the regulator valve plunger for a minimum clearance of 1/32 inch from the outer shoulder of the plunger to the bottom of the holes in the plunger body.

(5) Wash and clean all parts thoroughly and dry with compressed air. Lubricate all parts freely with clean oil and place in a tray that will keep parts from rolling around and banging against each other. Entirely avoid nicking and scratching the machined surfaces.

d. INSTALLATION.

(1) Install the relief valve body in the rear crankcase housing and tighten with wrench No. PWA-1604.

(2) Lubricate and install the relief valve plunger in the relief valve body.

(3) Install the compensating relief valve assembly and tighten with wrench PWA-1437.

CAUTION

Don't forget the gasket under the relief valve housing.

e. ADJUSTMENT.

(1) Start the engine and warm up in the normal manner.

(2) Allow the oil to reach at least 60°C (140°F) and adjust the compensating relief valve adjusting screw (17, figure 214A), to give a desired oil pressure of from 85 to 90 lb/sq in. at 2000 rpm.

(3) Tighten the adjusting screw lock nut securely.

(4) Install relief valve cap and gasket. Safety wire the relief valve assembly.

2. NON-COMPENSATING TYPE.

a. DESCRIPTION.—On the majority of C-47B's, the use of the compensating oil pressure relief valve and time delay control valve has been discontinued. This type is replaced by a simplified type of non-compensating relief valve, which eliminates the necessity of a thermostatic time delay control valve. Therefore, on C-47B's which have engines equipped with the non-compensating valve, the thermostatic time delay control valve will have been replaced with a Thermo Control Replacement Plug.

Note

Non-compensating relief valve assemblies may be used to replace the compensating type *without* replacing the thermostatic time delay control assembly with a plug.

b. REMOVAL.

(1) Unscrew oil pressure relief valve housing and lift out spring and valve (9, figure 214A).

(2) Unscrew the valve body from the rear crankcase using wrench No. PWA 1604.

(3) Unscrew the acorn cap from the relief valve housing.

(4) Loosen and remove the adjusting screw lock nut and adjusting screw.

(5) Wash parts thoroughly in a recommended solvent and place in a suitable container to prevent damage from contact with other metal parts.

c. DISASSEMBLY.

(1) Inspect valve body and plunger for nicks, wear, and damage to valve body threads.

(2) Reject the valve assembly if the valve body or valve plunger seat shows excessive wear.

(3) Remove small not-too-serious nicks and scratches by stoning and polishing with crocus cloth and oil.

d. INSTALLATION.

(1) Install valve, plunger body in rear crankcase, using wrench PWA 1604.

(2) Install plunger in valve body.

(3) Assemble adjusting screw and lock nut to relief valve housing.

(4) Install relief valve spring, pushing it into position against flange of adjusting screw.

(5) Install gasket on housing and screw housing into rear crankcase making sure that the relief valve spring is centered in the plunger.

CAUTION

Don't forget the gasket!

(a) ADJUSTMENT.—The adjustment of this valve is identical with that of the compensating type. See paragraph 6.*b.*(11)*(e)1.*e., preceding.

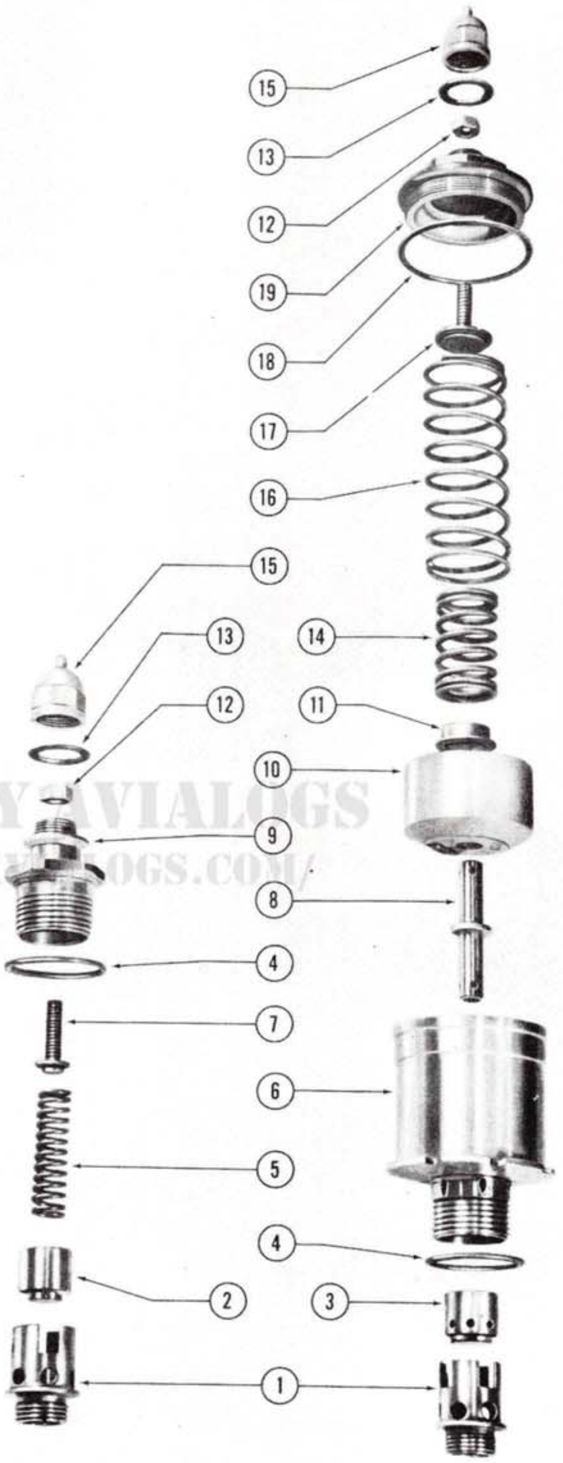


Figure 214A—Exploded Views of Oil Pressure Relief Valves

(f) OIL SUMP.

1. DESCRIPTION.—The main oil sump is located between cylinders 7 and 9 and collects oil drained from moving parts within the main crankcase and the rear cam compartment. The oil in this sump

KEY TO FIGURE 214A

Item No.	*Pratt & Whitney Part Number*	*Part Name*
1.	20495	Body—Compensating Relief Valve
2.	21577	Plunger—Non-Compensating Relief Valve
3.	37034	Plunger—Compensating Relief Valve
4.	41761	Gasket—1-3/16 in. ID x 1-7/16 in. OD x 3/32 in. thd, Compensating Relief Valve, Rear
5.	57789	Spring—Non-Compensating Relief Valve
6.	34281	Housing—Compensating Relief Valve
7.	8698	Screw—Oil Pressure Relief Adjusting
8.	37035	Valve—Compensating Relief
9.	57790	Housing—Oil Pressure Relief Valve
10.	47527	Piston Assembly—Compensating Relief Valve
11.	34280	Guide—Compensating Relief Valve Spring
12.	501	Nut—Plain, Oil Return Check Valve
13.	234	Gasket—⅝ in. ID, Compensating Relief Valve Cap
14.	34621	Spring—Compensating Relief Valve
15.	8699	Cap—Compensating Relief Valve
16.	34277	Spring—Compensating Relief Valve Piston
17.	44788	Screw—Compensating Relief Valve Adjusting
18.	28692	Gasket—2 in. ID x 2¼ in. OD x 5/64 in. thd, Compensating Relief Valve Cover
19.	34275	Cover—Compensating Relief Valve

NOTE: Identical part numbers indicate interchangeable parts. One each of the above is required for each valve assembly. Refer to figure 214A for the correct assembly of each valve.

is scavenged through an oil screen, a pipe in the bottom of the blower section, and a series of cored passages in the accessory section to the oil outlet port. This oil is scavenged by the middle section of the main oil pump.

2. REMOVAL.

a. Remove the oil scavenge pipe from the main oil sump and the oil pump.

b. Remove the nuts and cap screws which hold the sump in place. Remove the sump from the engine. Hold the rubber seals, inserts, and springs on the tubes, otherwise they will slide off when the sump is removed.

c. Remove the oil screen and plug assembly.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Clean the sump thoroughly.

b. Check for cracks, mutilated stud holes, damaged flanges, or plug threads.

c. On welded aluminum-type sumps, remove dents and check for cracks after dents are removed.

d. Examine sump for metal particles or other foreign matter. If metal chips are found, they indicate a probable engine failure and should be investigated. If chips are numerous, the sump screen should be removed and inspected.

4. ASSEMBLY AND INSTALLATION.

a. Install the oil screen and plug assembly in the front of the oil sump with a new gasket under the plug.

b. Install a spring, space, and a new rubber seal on each crankcase oil drain tube.

c. Place a new gasket on the blower section mounting pad and install the main oil sump, securing it with three washers and safety wire.

e. Tighten the nuts on the studs and secure with palnuts.

f. Install the oil drain plug in its insert at the bottom of the sump and safety wire.

(g) ROCKER BOX DRAIN SUMP.

1. DESCRIPTION.—The rocker box drain sump (figure 210A) is located between the rocker boxes of cylinder 8. Oil which drains into this sump from the engine's valve mechanisms is scavenged by the front scavenge pump.

2. REMOVAL AND DISASSEMBLY.

a. Remove the nuts and screws which secure the oil suction and breather pipe assembly to the reduction gear housing and rocker box oil sump. Then lift off the pipe assembly.

b. Withdraw the pipe assembly adapter from the reduction gear housing.

c. Remove the two plugs from the rear of the rocker box covers on No. 8 cylinder.

d. Unscrew the two hollow supports, using PWA-2210 wrench.

e. Remove the nuts which secure the rocker box covers to No. 7 inlet and No. 9 exhaust rocker housing.

f. Remove the two fillister head screws which fasten the sump to the rocker shafts of No. 8 cylinder.

g. Lift the sump from the engine together with the attached No. 7 inlet and No. 9 exhaust rocker covers.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Refer to maintenance information for main oil sump in *(f)* preceding.

4. ASSEMBLY AND INSTALLATION.

a. Install the rocker box sump, together with the No. 7 inlet and No. 9 exhaust rocker box covers to No. 8 cylinder head.

b. Install a star lock washer, rubber packing, and copper gasket on each hollow sump support.

c. Screw the two sump supports into position through the rocker box covers of No. 8 cylinder, using PWA-2210 wrench.

d. Install a cover plug and gasket in each rocker box cover of No. 8 cylinder.

e. Assemble a washer, rubber packing, and another washer, respectively, on each sump support screw. Then, secure the sump to each rocker shaft of No. 8 cylinder with the two sump support screws.

f. With a new gasket in place on the reduction gear housing install the suction and breather tube assembly adapter.

g. Place new gaskets in position on the rocker box sump and on the adapter. Install the suction and breather tube assembly, fitting the small dowel pin into position in the sump Secure the tube assembly to the sump with cap screws, and to the reduction gear housing with washers and nuts on the studs.

h. Install the oil drain plug in the rear of the rocker box oil sump, placing a gasket between the plug and the sump.

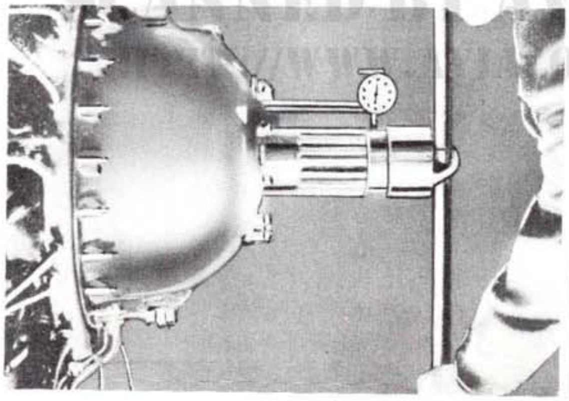
(12) (Deleted.)

(13) ENGINE TROUBLE SHOOTING CHART.—This chart outlines the most common symptoms of engine troubles, their possible causes, and remedies. It is intended to guide and expedite the work of the trouble shooter. Locating and correcting engine troubles should be accomplished by first studying the symptoms carefully and then checking each possible cause, beginning with the most probable, until the exact cause of the trouble is determined. Because some engine troubles are evident in only one range of engine speed, the engine's operation should be observed at low, medium, and high speeds, whenever possible.

Before attempting to work on an engine which has been reported as faulty in flight, consult the pilot's flight report and all other available sources for any pertinent information which might give a clue as to the cause of the trouble.

CAUSES	TROUBLES										REMEDIES
	Failure to Start	Rough Running	Low Power	Improper Idling	Improper Acceleration	High Oil Pressure	Low Oil Pressure	Oil Foaming	High Oil Temperature	Low Oil Temperature	
FUEL SYSTEM.											
Insufficient or fluctuating fuel pressure.	✓	✓	✓								Check fuel gage to make sure fuel tanks are full. Check operation of engine fuel and booster pumps.
Fuel leaks.	✓	✓									Check fuel lines, connections, joints, and clamps for tightness.
Underpriming.	✓										Increase priming. Check fuel booster pump pressure. If prime is still insufficient, check for clogged lines and leaks in system.
Overpriming.	✓										With ignition off and carburetor mixture control in idle cut-off, open the throttle fully and rotate propeller several times. Repeat starting procedure, maintaining priming to minimum.
Defective priming solenoid valve.	✓	✓	✓	✓							If prime fuel to cylinders is excessive, check priming solenoid valve for leakage and sticking. If prime fuel is insufficient, check booster pump. Repair or replace solenoid valve or pump if necessary.
Vapor in fuel system.	✓	✓									Operate booster pump, allowing vapor to vent from lines. Remove vent plug from carburetor, place mixture control in auto rich, and operate booster pump until fuel spurts from vent; then reinstall vent plug.
Excessive fuel pressure.		✓									Adjust fuel pump. Turn the adjustment screw to right to increase pressure, and to left to decrease pressure.
Incorrectly adjusted carburetor control linkage.		✓	✓								Adjust linkage so that movement of cockpit controls results in corresponding correct movement of throttle and mixture control levers.

CAUSES	TROUBLES										REMEDIES
	Failure to Start	Rough Running	Low Power	Improper Idling	Improper Acceleration	High Oil Pressure	Low Oil Pressure	Oil Foaming	High Oil Temperature	Low Oil Temperature	
Internal carburetor trouble.	✓	✓	✓	✓	✓						Replace carburetor.
Incorrect carburetor idle adjustment.				✓							Adjust carburetor idle mixture.
Improper grade of fuel.			✓								Drain fuel system. Fill tanks with fuel conforming to Specification No. AN-F-48, Grade 100/130.
Defective automatic mixture control unit.		✓	✓								Indicated by an engine which runs either too rich or too lean at altitude or at extreme ground temperature. The unit should be checked for proper setting at midpoint period between overhauls. Replace unit if necessary.
Dirt and grime on the venturi tubes.			✓								Remove the air screen and clean the venturi surfaces. The characteristics of lean metering, due to dirt on the boost venturis, is especially present at high airflows such as those encountered during climb and take-off operations. Such a condition may be evidenced by increased cylinder head temperatures.
IGNITION.											
Loose or defective spark plugs.	✓	✓	✓	✓							Tighten loose plugs to torque of 300 to 360 inch-pounds. Check for fouled plugs, plugs improperly gapped, or plugs having cracked ceramic insulation. Install reconditioned plugs.
Defective spark plug lead connectors.	✓	✓		✓							Clean dirty or oily connectors with a dry, clean cloth. If necessary, unleaded gasoline or Stoddard Solvent may be used. Replace cracked connectors.
Defective switch or improper ground wire connection.	✓										Check magneto switch and magneto ground wire circuit for proper operation.
Moisture or oil in magnetos.	✓	✓									Clean distributor terminal blocks, and distributor rotor with cleaning naphtha or unleaded gasoline. Use lintfree cloths.
Defective ignition wires.	✓	✓		✓							To determine that an ignition wire is defective, apply continuity and high voltage tests.
Internal magneto trouble.	✓	✓									Disconnect spark plug lead connector, turn engine over by starter and hold connector 1/4 to 3/8 inch from grounded surface. If there is no spark or if spark is weak, install new magneto.
Inoperative induction vibrator.	✓										If no buzzing sound is heard from vibrator when starter engaging switch is on, replace vibrator.
Defective magneto timing.		✓	✓								Check the magneto timing.
INDUCTION SYSTEM.											
Restrictions or leaks.	✓	✓	✓	✓							Remove air scoop from carburetor. Check air screen for foreign matter. Make sure that air scoop is clean. Check security of carburetor on engine and see that all intake nuts are tight. Check intake pipes for cracks.
Improper valve clearances.	✓	✓	✓	✓	✓						Adjust valve clearances.
Sticking valves.	✓	✓		✓	✓						Lubricate sticking valves. Replace cylinder if necessary.

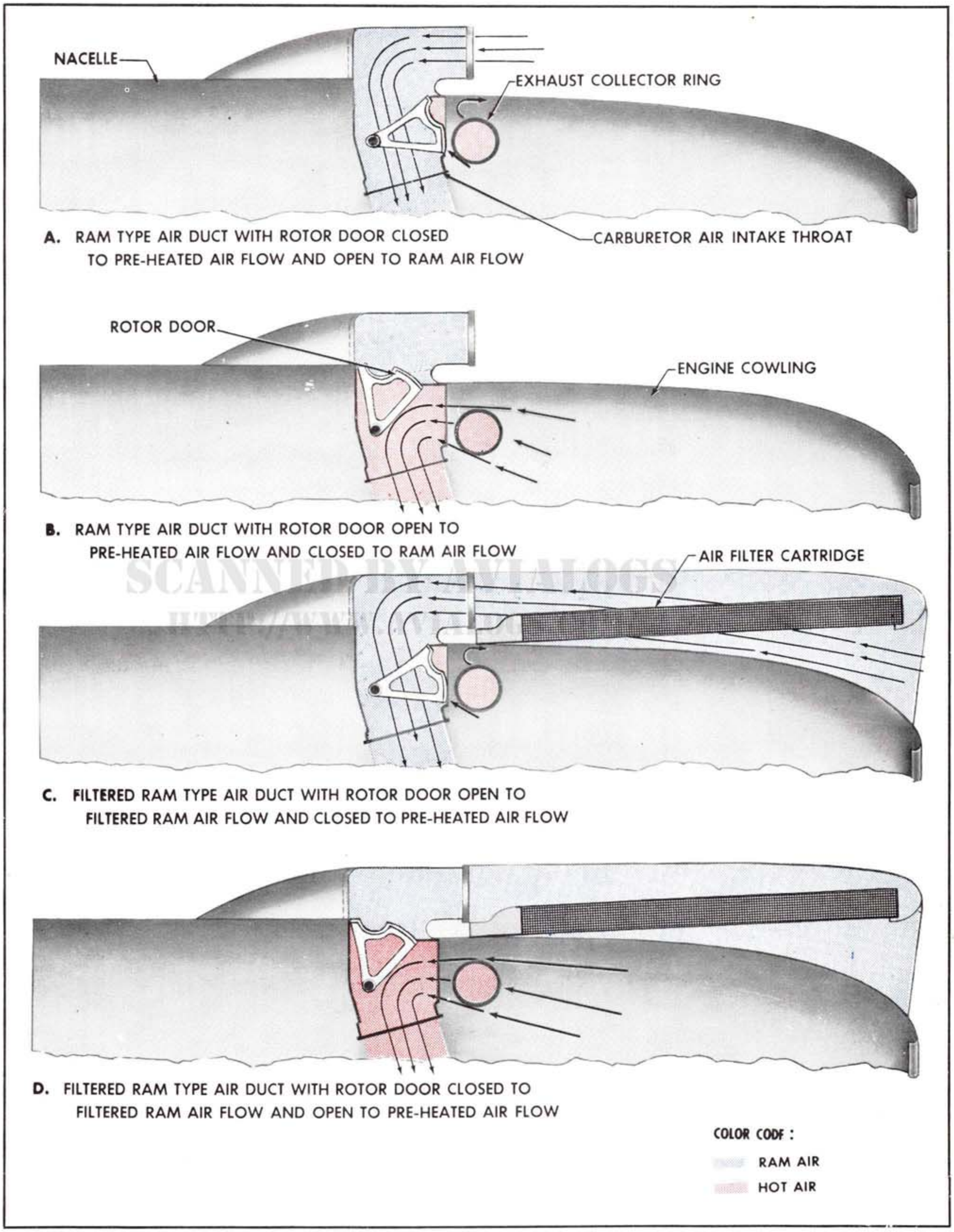
CAUSES	TROUBLES										REMEDIES
	Failure to Start	Rough Running	Low Power	Improper Idling	Improper Acceleration	High Oil Pressure	Low Oil Pressure	Oil Foaming	High Oil Temperature	Low Oil Temperature	
Broken valve springs.		✓	✓		✓						Install new springs.
Defective piston rings.		✓	✓								Replace cylinder assembly.
PROPELLER.											
Faulty operation of propeller or governor.	✓	✓									Refer to applicable Army and Navy technical publications.
Loose propeller retaining nut.		✓									Remove propeller. Inspect the propeller shaft splines for galling and cracking. Replace propeller and torque nut to 1000 foot-pounds.
Propeller not tracking evenly.		✓									Replace propeller.
Propeller out of balance.		✓									Replace propeller.
Excessive propeller shaft runout.		✓									Remove propeller from engine. Remove a spark plug from each cylinder and install a PWA-3252 Vent Plug in its place. Install a dial indicator on a convenient thrust bearing cover stud so that indicator plunger rests on rear cone seat. Install PWA-1333 Eye on propeller shaft; then place a bar through eye and turn propelled shaft in normal direction of rotation. The runout on rear cone seat should not exceed .005 inch full indicator reading. Readjust dial indicator and check runout on front cone seat. The runout on front cone seat should not exceed .015 inch full indicator reading. If propeller shaft runout exceeds these limits, withdraw engine from service until a new shaft is installed.
	 **Figure 214B—Checking Propeller Shaft Runout**										
Excessive propeller shaft radical clearance.		✓									Remove propeller from engine. Install dial indicator on a convenient thrust bearing cover nut and set the dial on the front cone seat 7 inches forward of the thrust-bearing cover plate. Lift the propeller shaft up and read the dial. Repeat this movement several times and take the readings. The amount of radial movement permitted is not to exceed .030 inch. If it is more, the front section should be removed and the radial play restored to a lesser value by replacing parts in the assembly which show the greatest wear. If it is noticed that the outer race of either of the propeller shaft rear bearings has shown a tendency to spin, it is recommended that the support plate liner or the front reduction drive coupling be replaced. If another front coupling is not readily obtainable, it may be desirable to copper plate the recess which accommodates the bearing. The plating should not exceed .001 inch thickness.

CAUSES	Failure to Start	Rough Running	Low Power	Improper Idling	Improper Acceleration	High Oil Pressure	Low Oil Pressure	Oil Foaming	High Oil Temperature	Low Oil Temperature	REMEDIES
MISCELLANEOUS.											
Loose air ducts.		✓									Check all air duct connections and supports. Tighten where necessary.
Loose exhaust manifolds.		✓									Check the exhaust manifolds and tighten loose nuts.
Loose cowling supports.		✓									Check all cowling supports and secure any loose supports.
Insufficient cranking speed.	✓										Check for weak batteries and condition of starter.
Loose or broken engine mounting brackets.		✓									Tighten loose flexible brackets to their proper torque. Replace broken brackets.
Loose thrust nut.		✓									Remove propeller. Inspect propeller shaft splines for cracking and galling. Tighten thrust nut. Replace propeller.
Improper starting procedure.	✓										Conform to starting instructions set forth in Pilot's Handbook for the particular engine.
Cold engine.				✓							Warm up engine thoroughly before permitting it to idle.
LUBRICATION SYSTEM.											
Inadequate oil supply.							✓		✓		Fill tank with oil conforming to Specification No. AN-O-8, Grade 1100 or 1120.
Water or impurities in oil.							✓	✓	✓		Drain engine and oil system. Fill tank with oil conforming to Specification No. AN-O-8, Grade 1100 or 1120.
Excessive oil dilution.							✓	✓	✓		Drain oil from engine. Check oil dilution valve operation. If valve leaks, check for dirt under valve seat and clean. If seat is worn or misaligned, or if valve spring is broken, replace unit.
Clogged main oil screen.							✓		✓		Remove and clean screen.
Defective oil pressure relief valve.						✓	✓				Remove, clean, and inspect relief valve. If spring is defective, replace spring. When relief valve has one been set correctly, do not readjust to remedy variations in engine oil pressure.
Improper operation of oil cooler.									✓	✓	Check oil cooler shutter control operation. Check for obstructions in cooler. Replace cooler or control unit if necessary.
Obstructions or leaks in oil lines.							✓		✓		Check all oil lines and remove any obstructions.
Broken or defective oil pressure gages.							✓				Replace gages.
Improper functioning of oil pump.							✓				Replace oil pump.

c. ENGINE ACCESSORIES.

(1) CARBURETOR AIR INDUCTION SYSTEM.

(a) GENERAL.—Three basic types of carburetor air induction systems have been installed to introduce air into the carburetor: ram, ram filtered and ram non ram filtered.


NACELLE
EXHAUST COLLECTOR RING
CARBURETOR AIR INTAKE THROAT
ROTOR DOOR
ENGINE COWLING
AIR FILTER CARTRIDGE
COLOR CODE:
RAM AIR
HOT AIR

A. RAM TYPE AIR DUCT WITH ROTOR DOOR CLOSED TO PRE-HEATED AIR FLOW AND OPEN TO RAM AIR FLOW

B. RAM TYPE AIR DUCT WITH ROTOR DOOR OPEN TO PRE-HEATED AIR FLOW AND CLOSED TO RAM AIR FLOW

C. FILTERED RAM TYPE AIR DUCT WITH ROTOR DOOR OPEN TO FILTERED RAM AIR FLOW AND CLOSED TO PRE-HEATED AIR FLOW

D. FILTERED RAM TYPE AIR DUCT WITH ROTOR DOOR CLOSED TO FILTERED RAM AIR FLOW AND OPEN TO PRE-HEATED AIR FLOW

Figure 215—Principle of the Ram and Filtered Ram Air Induction System

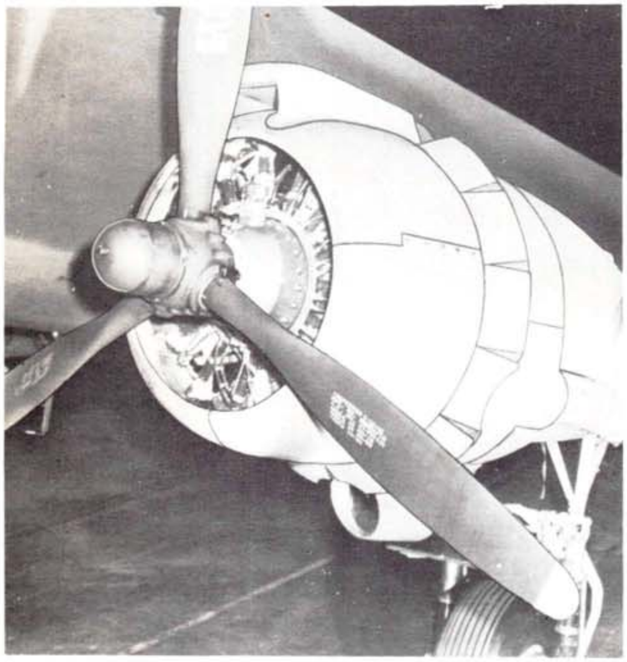


Figure 216—Filtered Ram Type Air Scoop

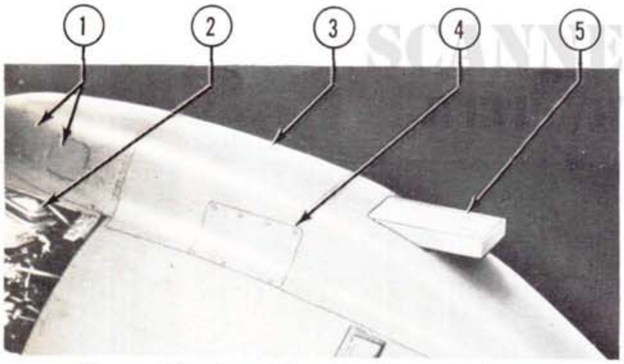


Figure 217—Ram Non Ram Type Air Scoop

1. Ram-Non Ram Mechanism Access Covers
2. Carburetor Air-Intake Throat
3. Oil Tank Dip Stick Access Cover
4. Oil Tank Filler Neck Access Cover
5. Carburetor Non Ram Air Filter

1. The ram or scoop type, on C-47 and some C-47A airplanes, consists of a small duct or scoop located on the top forward edge of the engine accessory cowling. This small duct routes the air directly to the carburetor.

2. The second type, ram filtered, on C-47 and some C-47A airplanes, consists of the same type small duct but, in addition, extends a filter duct, a detachable unit, to the leading edge of the anti-drag ring to introduce filtered ram air to the carburetor.

3. The third type, ram-non ram filtered ("non ram"), consists of three designs. The first design, used on some late C-47A airplanes, contains hydraulically operated doors. The second design, used on 300 early C-47B airplanes, contains electrically operated doors. The third design, used on other C-47B airplanes, contains manually operated doors. The fairing of these designs extends from the leading edge of the engine accessory cowling to approximately halfway back on the top of the nacelle. Ram air is introduced through the front opening of the fairing and filtered non ram air is introduced through the opening near the top aft end of the fairing.

(b) RAM TYPE. *(See A and B, figure 215.)*—This direct ram type duct is riveted to the accessory cowling and the duct is not removable. A door-like valve in the air-intake throat directly above the carburetor may be opened to permit hot air to be drawn into the carburetor from around the exhaust collector ring. This valve is controlled by the carburetor hot air control levers on the engine control pedestal. (Refer to paragraph 6.*e.*(4).) When the hot air door is opened, the ram air entrance is closed so that the ram air is by-passed through the side of the scoop.

(c) RAM FILTERED TYPE.
(See C and D, figure 215 and figure 216.)

1. DESCRIPTION.—This ram filtered type is the direct ram type with a fairing added to house a filter. It is larger than the scoop described above, extending forward to the leading edge of the anti-drag ring. The additional length allows room for an air filter which is installed in the front end of the duct. The filter housing is removable, being fastened to the anti-drag ring with Dzus fasteners. The carburetor hot air control valve and its operation is the same as the ram type above.

2. REMOVAL OF AIR FILTER.

a. Release the Dzus fasteners on both sides of the forward section of the duct.

b. Lift the forward section of the duct free from the anti-drag ring.

c. Remove the air filter.

3. MAINTENANCE OF AIR FILTER.—Refer to paragraph 6.*c.*(1)*(g)2.* following.

4. INSTALLATION.—The air filter and forward section of the air duct may be installed by reversing the removal procedure.

Note

Always replace the air filter with the fine screen up.

(d) RAM NON RAM TYPE. (Hydraulic.)
(See figures 217 and 218.)

1. DESCRIPTION.—The ram non ram ("non ram") type air scoop extends from the leading edge of the accessory cowling to approximately halfway back on top of the nacelle. The front opening in the scoop provides the direct, or "ram" air. The opening on top aft end of the duct together with the air filter provides the non ram feature. Flow of air through the carburetor

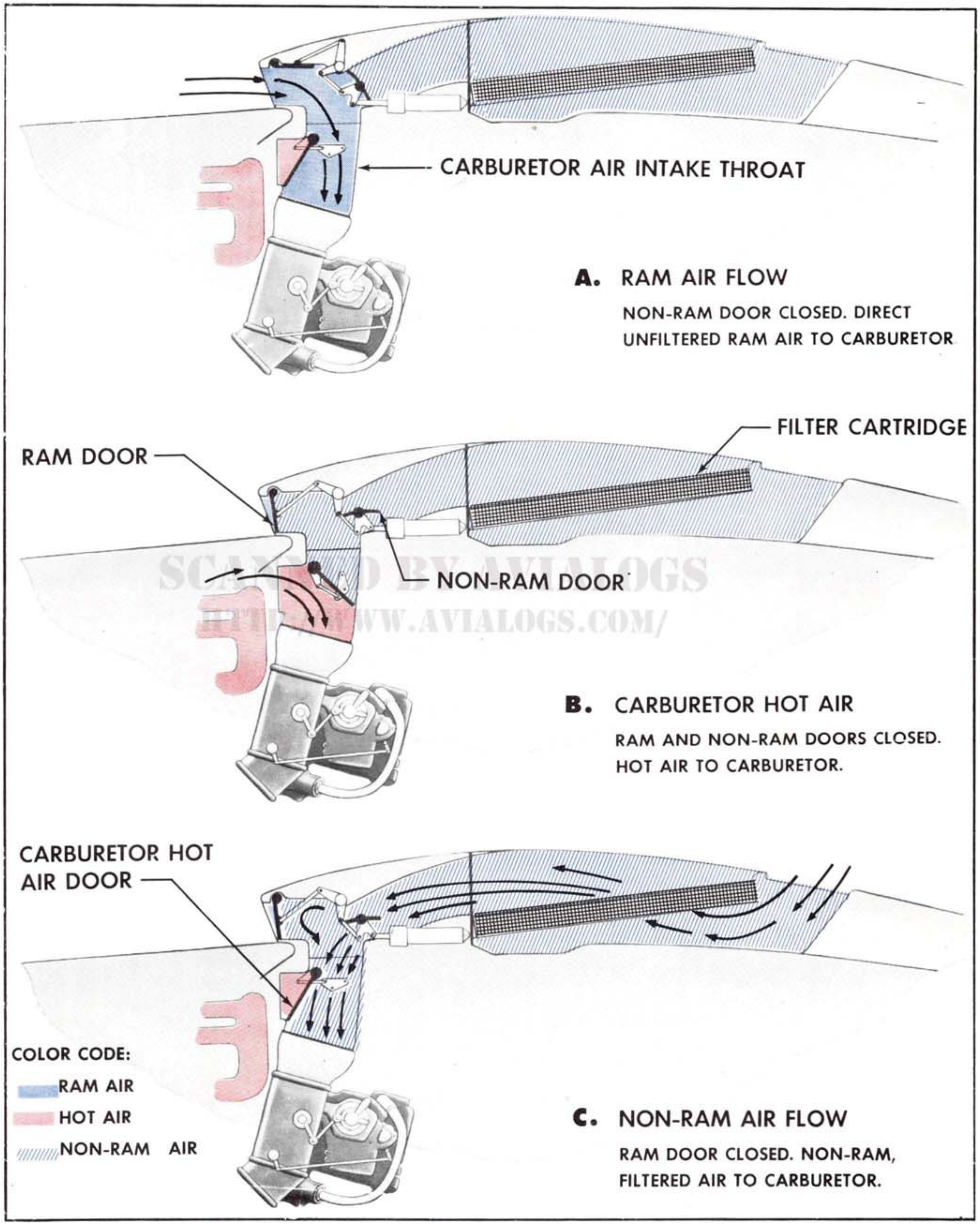

CARBURETOR AIR INTAKE THROAT
A. RAM AIR FLOW
NON-RAM DOOR CLOSED. DIRECT UNFILTERED RAM AIR TO CARBURETOR
FILTER CARTRIDGE
RAM DOOR
NON-RAM DOOR
B. CARBURETOR HOT AIR
RAM AND NON-RAM DOORS CLOSED. HOT AIR TO CARBURETOR.
CARBURETOR HOT AIR DOOR
COLOR CODE:
RAM AIR
HOT AIR
NON-RAM AIR
C. NON-RAM AIR FLOW
RAM DOOR CLOSED. NON-RAM, FILTERED AIR TO CARBURETOR.

Figure 218—Principle of Hydraulically Operated Ram Non Ram Air Induction System

air scoop is controlled by the ram door inside the front opening of the scoop and the aft butterfly door located farther back at the end of the non ram channel. These two doors are connected by linkage and are operated simultaneously by a hydraulic actuating cylinder mounted in the wall of the scoop. When the hydraulic cylinder is "EXTENDED," the ram door is "OPEN" and the aft butterfly door is "CLOSED." This allows ram air to be supplied directly to the carburetor. When the hydraulic cylinder is "RETRACTED," the opposite action takes place. That is, the ram door is "CLOSED" and the aft butterfly door is "OPEN," allowing filtered air to enter the carburetor. The hydraulic actuating cylinder that operates these two doors is controlled by a valve located on the bulkhead behind the pilot's seat. (See paragraph 13.*b*.) This valve is marked on early installations "NON RAM AIR FILTER" and has three positions: "OPEN," "CLOSED" and "OFF." On some airplanes these positions are "FILTERED," "UNFILTERED" and "LOCKED." When operating this valve for testing or in actual use, turn the indicator to the desired "OPEN" or "CLOSED" position for several seconds which is long enough for the hydraulic action to operate the doors. The indicator should then be returned to the "OFF" or "LOCKED" position. The doors will stay in this desired position or until moved to the opposite position by further use of this control valve. When the control is moved to "OPEN" position, the non ram door is "OPEN" and the ram door is "CLOSED." Carburetor heat is controlled by the operation of a valve door in the air-intake throat, just above the carburetor. The carburetor hot air door is operated by controls on the engine control pedestal. (Refer to paragraph 6.*e*.(4).) The carburetor heat rise is registered on the carburetor air temperature indicator located on the right-hand instrument panel in the pilots' compartment. When this door is "OPEN" the heated air from the shrouded area of the collector ring is allowed to enter the induction system. Simultaneously, the cool ram and non ram air flow is shut off.

2. REMOVAL.

a. REMOVAL OF FORWARD SECTION.

(1) Disconnect all lines (hydraulic and deicer) at the point where they enter the carburetor air scoop. Loosen rubber collar and clamps between duct and carburetor adapter.

(2) Release the Dzus fasteners securing the scoop to the accessory cowling and to the supports forward of the firewall.

(3) Remove the forward section of the carburetor air scoop.

b. REMOVAL OF AIR FILTER.

(1) Remove the screws from the plate that holds the air filter cartridge in place. This plate is located inside the non ram scoop opening.

(2) Remove the air filter cartridge by sliding it back and out through the non ram opening.

c. REMOVAL OF HYDRAULIC ACTUATING CYLINDER.—Refer to paragraph 13.*b*.(3)*(b)*.

3. MAINTENANCE OF AIR FILTER.—Refer to paragraph 6.*c*(1)*(g)2*. following.

4. MAINTENANCE OF DOOR OPERATING MECHANISM.

a. Check all bearing rod ends to see that they operate freely. Replace worn or damaged parts.

b. For maintenance of the hydraulic actuating cylinder, refer to paragraph 13.*b*.(3)*(c)*.

5. INSTALLATION.—The air filter cartridge and the front section of the carburetor air scoop may be installed by reversing the removal procedure.

CAUTION

> The air filter cartridge must be installed with the fine screen side up.

6. ADJUSTMENTS.—If the ram door or butterfly door is not seating correctly, adjustment may be made by adjusting the link rods between the hydraulic actuating cylinder and the doors and the linkage between the two doors. These link rods may be reached by removing the round access plate on top of the air duct and adjustment is made by loosening the lock nut and turning the link rod in the bearing rod end. For adjustments on the carburetor hot air controls, refer to paragraph 6.*e*(4)*(e)*.

(e) RAM NON RAM FILTERED TYPE
(Electrical). *(See figure 218a and 218b.)*

1. DESCRIPTION.—This air scoop is similar in appearance to the hydraulically operated scoop, however, the internal air ducts are functionally identical and the operation is controlled from the pilot's compartment by two five-position electrical switches.

KEY TO FIGURE 218A

1. Front of Induction Valve Door
2. Rear Door
3. Cam Riding Bearing
4. Barber Colman Electric Motor
5. Filter Inspection Door
6. Filter
7. Air Deflector
8. Pulley Assembly
9. Accessory Cowling
10. S-2074407—4—42516 Cable Assembly
11. 2207194 Cable Assembly
    AN 155-166 Turnbuckle
12. Pulley-Cam Assembly
13. Eccentric Bolt
14. Small Cam Radiant
15. Access Door
16. Limit and Micro Switch
17. Linkage Rod Assembly
18. Adjustment Screw
19. Mouse Trap Door
20. Access Door
21. Aft Fairing Assembly

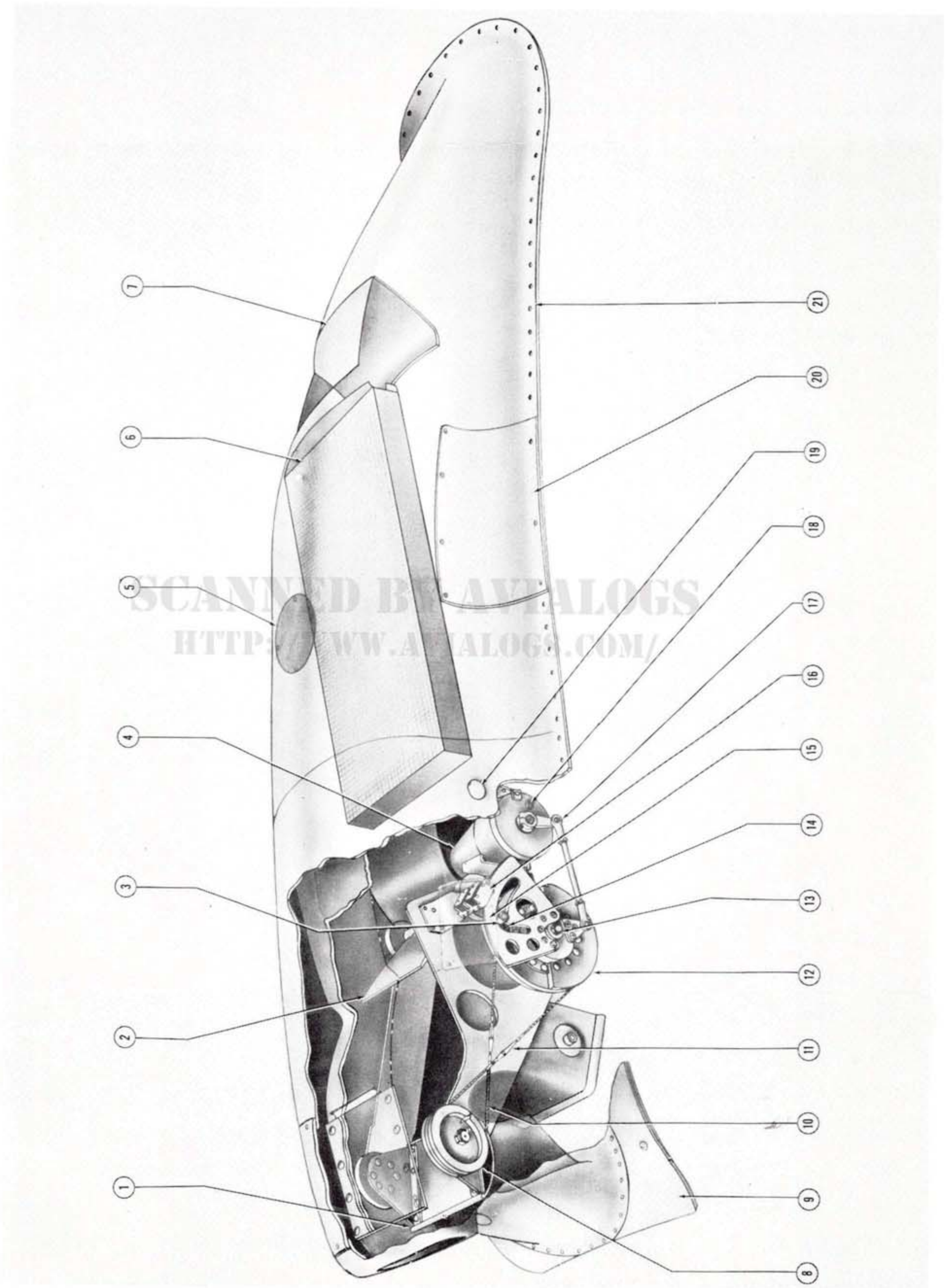
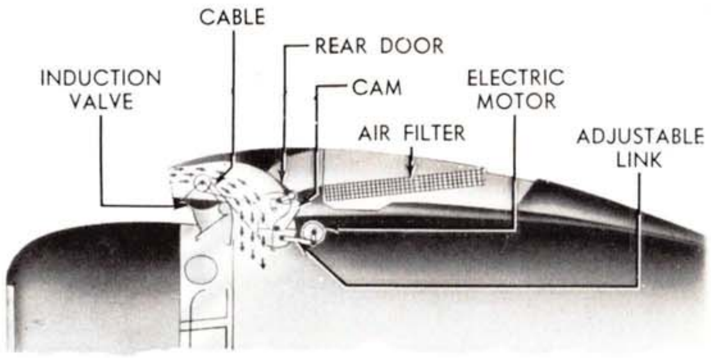
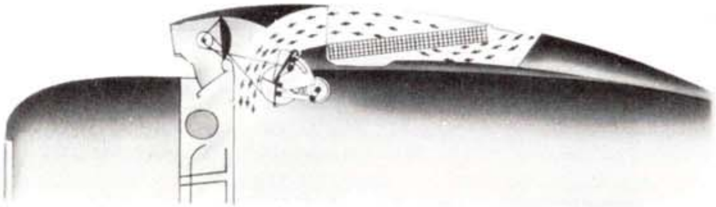

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

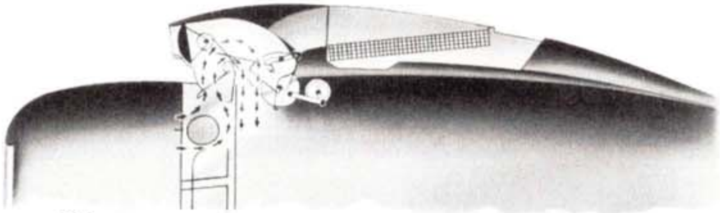
Figure 218A—Electrically Operated Ram Non Ram Assembly


INDUCTION VALVE
CABLE
REAR DOOR
CAM
AIR FILTER
ELECTRIC MOTOR
ADJUSTABLE LINK

Ⓐ **RAM AIR FLOW TO CARBURETOR**
NON-RAM AIR DUCT CLOSED BY REAR DOOR.
HOT AIR DUCT CLOSED BY INDUCTION VALVE.

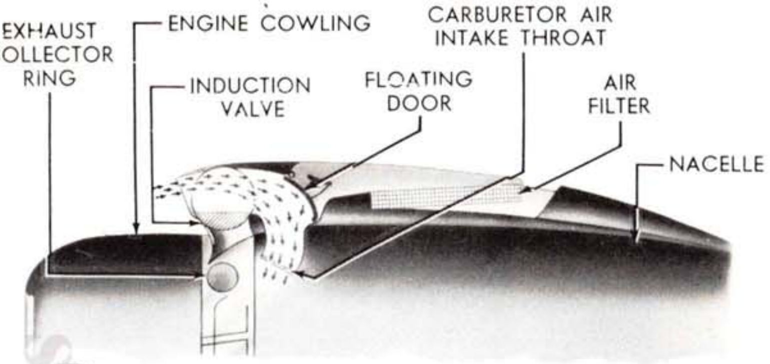


Ⓑ **NON-RAM FILTERED AIR FLOW TO CARBURETOR**
RAM AIR DUCT CLOSED BY INDUCTION VALVE.
REAR DOOR SWUNG OPEN.

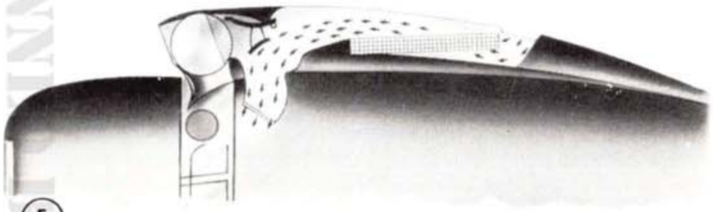


Ⓒ **HOT AIR FLOW TO CARBURETOR**
RAM AIR DUCT CLOSED BY INDUCTION VALVE.
NON-RAM AIR DUCT CLOSED BY REAR DOOR.

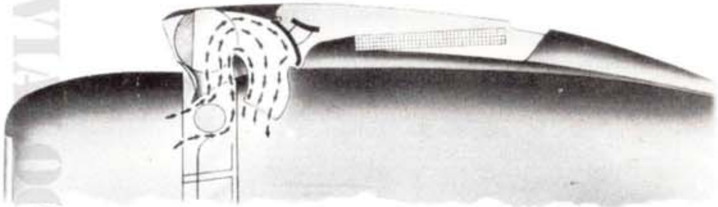
THIS CARBURETOR AIR INDUCTION SYSTEM
EFFECTIVE ON EARLY C-47B MODEL AIRPLANES


EXHAUST COLLECTOR RING
ENGINE COWLING
INDUCTION VALVE
FLOATING DOOR
CARBURETOR AIR INTAKE THROAT
AIR FILTER
NACELLE

Ⓓ **RAM AIR FLOW TO CARBURETOR**
NON-RAM AIR DUCT CLOSED BY FLOATING DOOR.
HOT AIR DUCT CLOSED BY INDUCTION VALVE.



Ⓔ **NON-RAM FILTERED AIR FLOW TO CARBURETOR**
RAM AIR DUCT CLOSED BY INDUCTION VALVE.
FLOATING DOOR SWUNG OPEN.



Ⓕ **HEATED AIR FLOW TO CARBURETOR**
RAM AIR DUCT CLOSED BY INDUCTION VALVE.
NON-RAM AIR DUCT CLOSED BY FLOATING DOOR.

THIS CARBURETOR AIR INDUCTION SYSTEM
EFFECTIVE ON LATER C-47B MODEL AIRPLANES

Figure 218B—Principle of Electrically and Manually Operated Ram Non Ram Air Induction Systems

By means of limit and micro switches, the electrical circuits control the operation of a Barber-Coleman electric motor (ALYC5091) which, through a cam and cable system, operates the two doors—front or induction valve door, and rear door. The induction valve is actuated by a cable from the pulley-cam assembly which in turn is actuated by the electric motor. Simultaneously, the rear door is actuated by the cam motion of the pulley-cam assembly. To reduce the possibility of damage to the carburetor air filter operating mechanism or malfunctioning of the air ram operating cylinder, caused by excessive travel of the cylinder rod, a limiting spacer is installed on the cylinder.

To induct cold ram air, the induction valve is in its down position to close off the hot air intake and the rear door is in ram position to close off the non ram air duct.

To induct cold filtered air, the induction valve is in its back position to close the ram air duct and the rear door is in the non ram position to allow air to pass through the filter.

To induct hot air, the induction valve is in the front position to close off the ram air intake and the rear door is in the ram position to close off the non ram air duct. This permits hot air to be drawn off the exhaust collector ring into the carburetor.

Obtain full HOT AIR, full FILTER AIR or FULL COLD (RAM) air by placing the pointer of the selector switch in the pilot's compartment on the required position. The pointer on the selector switch must be turned in clockwise motion; counterclockwise motion will not operate the electric motor.

2. ACCESSIBILITY TO SCOOP MECHANISM.

a. To reach the mechanism of the air induction system for servicing of micro switches, remove the access doors on side of fairing by taking out the Reed and Prince screws.

b. For servicing of doors and cam assembly remove left-hand access cowling. Disconnect the linkage between the motor and the pulley-cam assembly.

3. ADJUSTMENTS.

a. Disconnect the linkage between the motor and the pulley-cam assembly.

b. Looosen the eccentric bolt that mounts the pulley-cam assembly and adjust the rear door so that it seals against the door jam in the closed (ram) position, the cam riding bearing should be approximately one-eighth inch aft of the small cam radiant. It is important that the door not have any appreciable pre-load when it is adjusted.

c. Adjust the turnbuckles in the cable assembly to sychronize the induction valve in down position and the rear door in ram position as in adjustment b, above. Note: Cable tension must be eight to ten pounds. 1/32 clearance must be maintained around both valve and door.

d. Loosen the motor clamp attaching to the support bracket to allow the motor to rotate.

e. Adjust the linkage arm to give the dimension of 6⅝ inches ± 1/16 inch and connect the linkage to the motor.

f. Adjust the electric motor position:

(1) Run the motor to the full forward (HOT AIR) position until the forward limit switch in the motor cuts the circuit.

(2) Apply enough tension on the motor clamp attaching bolts to secure the motor position until the adjustment procedure is completed.

(3) Reverse the motor by turning the selector switch to NON RAM. Adjust the rear limit switch in the motor so as to stop the doors in the position shown in figure 218b. Adjustment screw is located on the driving face of the motor.

(4) Tighten the motor clamp attaching bolts to the required tension.

(5) Synchronize the two micro switches to operate simultaneously (located inside the access door on the L.H. side of the air scoop over the pulley-cam assembly). When the pointer of the selector switch indicates FULL COLD (RAM) the motor will stop in the same position whether or not it is returning from FILTER or HOT AIR positions.

4. REMOVAL OF AIR SCOOP.

a. Detach deicer lines at connection in back of manifold. Loosen rubber collar and clamps between duct and carburetor adapter.

b. Disconnect electrical wiring at pull plug.

c. Remove top access door by loosening fasteners.

d. Reach through the top access door and release the two Dzus fasteners inside the forward end of the fairing: one in left hand corner and one in right hand corner.

e. Reach through mouse trap doors and release the two Dzus fasteners inside the aft end of the fairing: one in left hand corner and one in right hand corner.

f. Release the four Dzus fasteners on outside of fairing: two on the front corners and two on the aft corners.

g. Lift off the duct and mechanism assembly.

5. REMOVAL OF AIR FILTER.—Refer to paragraph *6.c.*(1)*(d)*2.b.

6. MAINTENANCE OF AIR FILTER.—Refer to paragraph *6.c.*(1)*(g)2.* following.

7. MAINTENANCE OF DOOR OPERATING MECHANISM.

a. Check all bearings and rod ends to see that they operate freely. Replace worn or damaged parts.

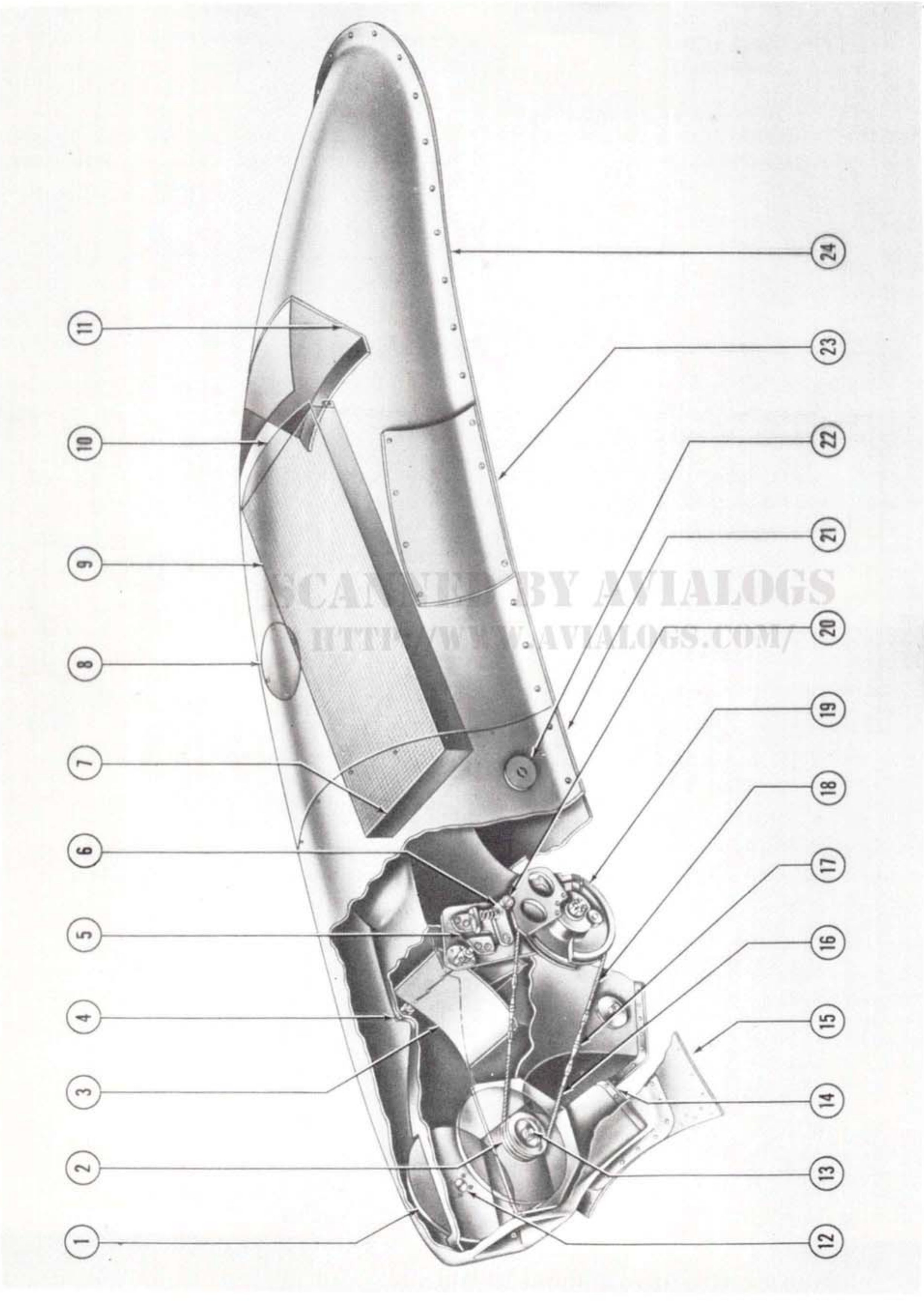

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24

Figure 218C—Manually Operated Ram Non Ram Assembly

b. Inspect both pulleys. Replace if damaged.

c. Check all cables. Replace any cable that shows more than six wires broken in any one inch.

8. INSTALLATION OF AIR FILTER.—The air filter cartridge may be installed by reversing the removal procedure.

CAUTION

The air filter cartridge must be installed with the fine screen side up.

(f) RAM NON RAM FILTERED TYPE (MANUAL). *(See figures 218b and 218c.)*

1. DESCRIPTION. — The exterior appearance, the air ducts, and functions of this design are similar to the electrically operated scoop except the actuating mechanism which is manually operated. The air induction valve is actuated by rods, bell cranks and cables running to the right hand side of the pilot's engine control pedestal. (Refer to paragraph *6.e.*(4).) The floating aft door, that opens and closes the non ram air duct, is fully automatic, using the pressure differential within the scoop to hold it in a required position. Three different flows of air may be selected, namely: HOT, RAM, and FILTERED. The positions required are made by operating the control levers on the engine control pedestal and locking them with the brake lever.

2. REMOVAL OF FORWARD COWLING.

a. Release the Dzus fasteners that secure the scoop to the accessory cowling and to the supports forward of the firewall.

KEY TO FIGURE 218C

1. Plate Assembly (Air Induction Valve)
2. Pulley Assembly
3. Floating Door
4. Floating Door Shaft
5. Bracket
6. Arm
7. Felt
8. Filter Inspection Door
9. Filter
10. Seal Assembly
11. Air Deflector
12. 1209906 Shaft
13. 2209914 Shaft
14. Hot Air Duct Assembly
15. Accessory Cowling
16. 2074407—5—5—1808 Cable
17. Turnbuckle
18. 2074407—4—4—2500 Cable
19. Pulley and Cam Assembly
20. Torrington Needle Bearing
21. Forward Fairing Assembly
22. Bullet Patch Plate Cover
23. Access Door
24. Aft Fairing Assembly

b. Remove the forward section of the scoop.

3. REMOVAL OF DUCT AND MECHANISM ASSEMBLY.

a. Detach deicer lines at connection in back of the manifold. Release actuating rod from pulley-cam assembly. Loosen rubber collar and clamps between duct and carburetor adapter.

b. Uncover the four round access holes, located on the forward and aft ends of the duct assembly, by releasing the screws that hold on the four bullet plate covers.

c. Reach down inside the four round access holes with a screwdriver and release the four Dzus fasteners.

d. Release the four Dzus fasteners on corners of the duct cowling.

e. Remove the whole duct and mechanism assembly.

4. REMOVAL OF AIR FILTER.—Refer to paragraph *6.c.*(1)*(d)2*.b.

5. MAINTENANCE OF AIR FILTER. Refer to paragraph *6.c.*(1)*(g)2*.

6. MAINTENANCE OF DOOR OPERATING MECHANISM.

a. Check all bearings and rod ends to see that they operate freely. Replace worn or damaged parts.

b. Check pulleys and replace if damaged.

c. Check all cables. Replace any cable that shows more than six broken wires in any one inch.

7. ADJUSTMENTS.

a. Adjust the turnbuckles in the cable assembly to a cable tension of eight to ten pounds; 1/32 clearance must be maintained around both the induction valve and the floating door.

b. Adjust the push-pull rods on the fire wall until the two carburetor heat control levers are exactly even when in the RAM position. Allow approximately a ¾ inch clearance or "spring back" on both levers at each extreme of their travel. It is possible to tell when the induction valve is completely in any of its three positions by listening while the control levers are placed in full position. A decided "clank" can be heard from inside the air scoop when the valve moves into full position.

8. INSTALLATION.—The air filter and the front section of the air scoop may be installed by reversing the removal procedure.

CAUTION

The air filter must be installed with the fine screen side up.

(g) FILTERS.

1. DESCRIPTION.—Each of the ram and ram non ram type systems contains a viscous impingement (oil screen) filter which cleans the air by bringing it into forcible contact with oil coated baffles. Air filters are mandatory for desert operation. Filters from several manufacturers are used. The filter of the second type system, ram filtered, is shorter and wider than the filter for the third type system, ram-non ram, therefore not interchangeable with the latter. The filters required for the third type system, ram-non ram, are interchangeable for each of its designs: electrical, hydraulic and manual.

2. MAINTENANCE OF THE AIR FILTER.

a. Inspect filters daily for contamination and proper oiling.

b. If inspection reveals evidence of dirt or insufficient oiling, clean as follows:

(1) Wash in gasoline or other suitable volatile cleaning fluid. While cleaning, rock the filter element or agitate the cleaning fluid to insure removal of dirt from the innermost part of the element.

(2) Thoroughly dry the filter element.

(3) Immerse from two to five minutes in a mixture composed of one part corrosion-preventive compound, Specification No. AN-VV-C-576, and three parts of lubricating oil, Specification No. AN-O-8, grade 1120.

(4) Drain the element from two to four hours to remove excess oil prior to reinstallation.

Note

It is imperative that, after washing in gasoline or volatile cleaning fluid, the element be thoroughly dried prior to immersing in oil; otherwise, the air filter will not be properly coated, resulting in impaired cleaning efficiency.

(2) CARBURETOR.

(a) DESCRIPTION.—Engines on C-47 and C47A airplanes are equipped with PD12-H4 Bendix-Stromberg downdraft, injection carburetors (figures 219 and 220). Engines on all C-47B airplanes are equipped with PD12-F5 carburetors. The carburetor is divided into the following five parts: main throttle body, automatic mixture control unit, fuel regulator unit, fuel control unit, and an adapter unit. This impeller and blower section

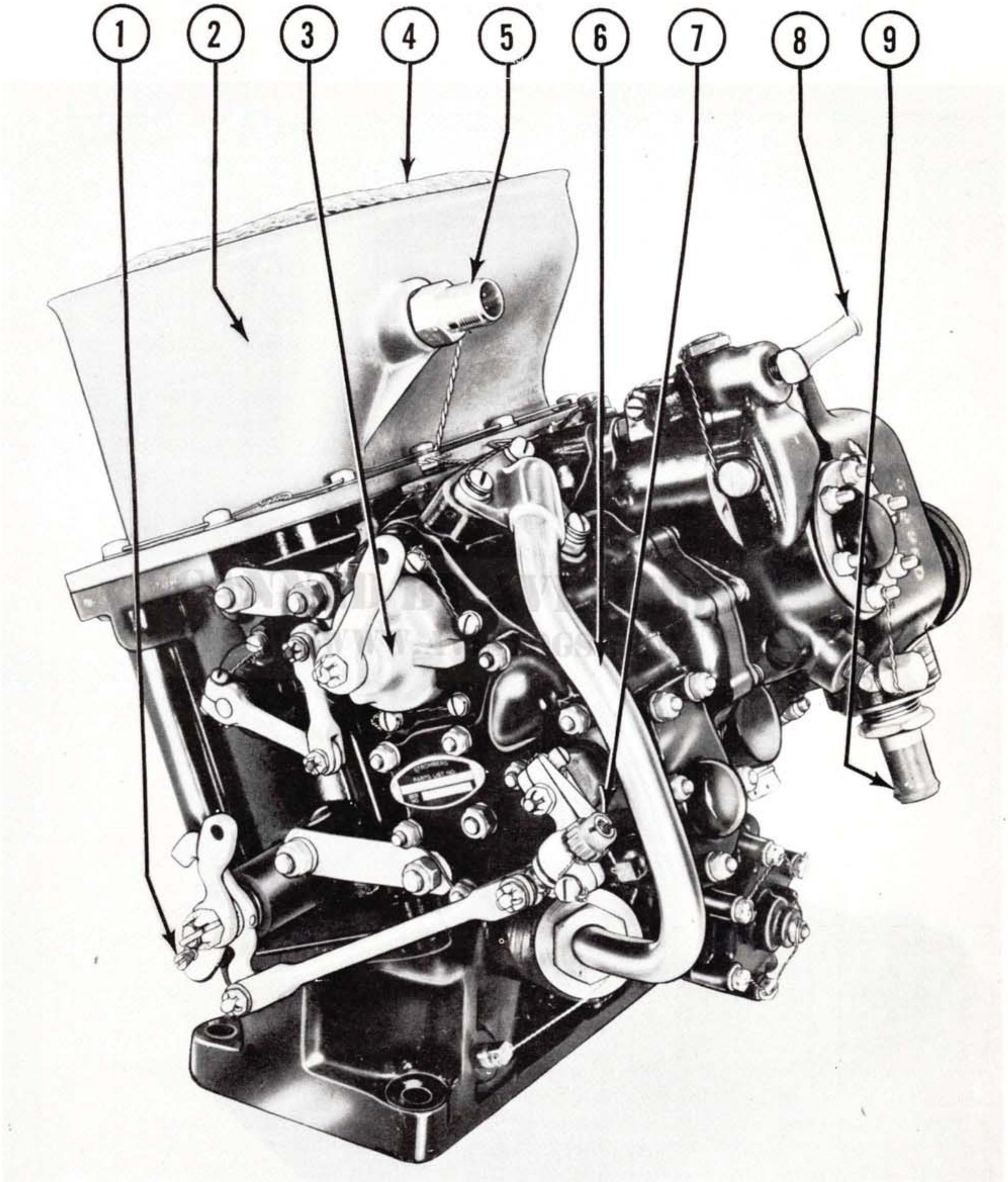


Figure 219—Bendix-Stromberg Injection Carburetor

1. Throttle Stop
2. Air Scoop Adapter
3. Manual Mixture Control
4. Air Scoop Screen
5. Air Temperature Gage Resistance Bulb
6. Fuel Transfer Line
7. Idle Adjusting Mechanism
8. Carburetor Fuel Vent Line
9. Fuel Inlet Line

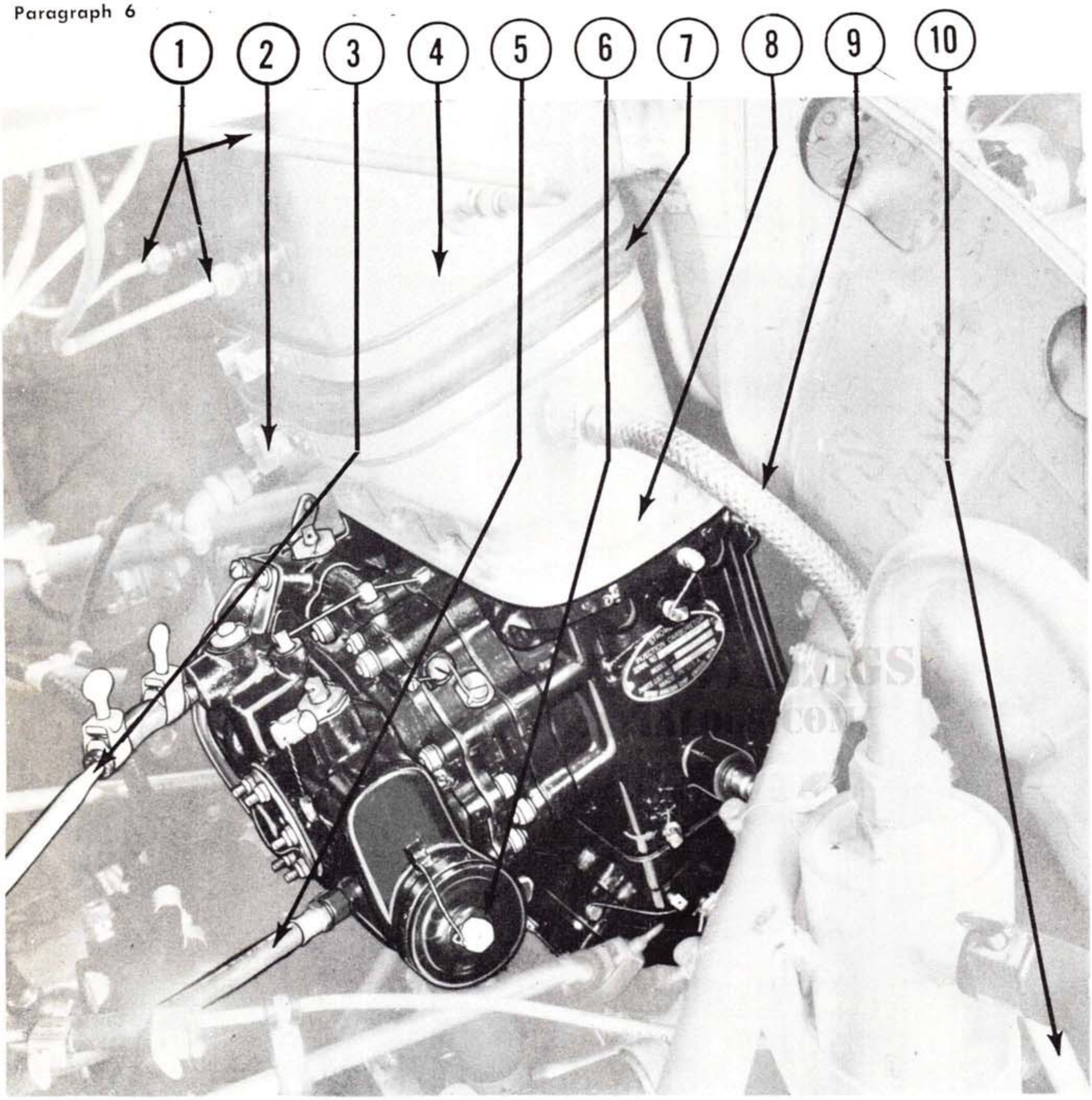


Figure 220—Carburetor Installed

1. Carburetor Anti-Icer Lines
2. Air Temperature Gage Resistance Bulb Electrical Connection
3. Carburetor Fuel Vent Line
4. Carburetor Air-Intake Throat
5. Fuel Pressure Line
6. Carburetor Strainer
7. Neoprene Sleeve
8. Adapter
9. Fire Extinguisher Line
10. Fire Extinguisher Line

of the engine may be seriously damaged if the screen between the carburetor and the air scoop adapter is removed. If these screens are removed, there is nothing to prevent foreign matter from entering the engine; also, the metering action of the carburetor may be upset.

1. THROTTLE UNIT. — Air is taken in through the air scoop and flows to the two-barreled throttle unit. Each barrel contains a large venturi, a boost venturi, and eight small impact tubes, which are located around the top of the large venturi. The throttle butterfly valves control the amount of incoming air.

The difference in air pressure between the impact tubes and the boost venturi throat is a measure of the amount of air entering the engine.

2. AUTOMATIC MIXTURE CONTROL.—The automatic mixture control unit is mounted in the top of the throttle body. This unit contains a sealed metallic bellows which is filled with nitrogen and oil and is sensitive to changes in carburetor air density and temperature. The unit operates to maintain a constant fuel-air ratio regardless of the density of the air. For example, at higher altitudes the automatic mixture control unit will automatically cause a diminishing of the fuel supply to maintain the correct fuel-air ratio in the less dense air.

3. REGULATOR UNIT.—The regulator unit has an air chamber and a fuel chamber. Each chamber is divided into two sections by diaphragms which are installed on the main fuel poppet valve shaft. The incoming air pressure produces both an air metering force and a vacuum metering force which acts on the air diaphragm. This force moves the fuel poppet and the fuel diaphragm, permitting fuel to flow to the main discharge nozzle. The carburetor mixture control may be set in one of four positions: "IDLE CUT-OFF," "AUTO-LEAN," "AUTO-RICH," or "EMERGENCY RICH." The desired ratio of fuel to air is determined by the setting of the control, the density of the air, and the mass air flow through the body of the carburetor. The mass air flow through the body of the carburetor is controlled by the throttle butterfly valve. The amount of fuel flow and the main discharge nozzle is dependent on the desired mixture and throttle settings.

4. FUEL CONTROL UNIT.—The fuel control unit contains fixed metering jets, the idle mixture metering jet, the power enrichment valve, and a four-position mixture control selector valve.

5. ADAPTER UNIT.—The adapter unit is attached to the base of the throttle body and serves as a mounting unit for attaching the carburetor to the engine blower case. The adapter unit contains the main discharge nozzle and the vacuum-operated acceleration pump. When the throttle butterfly valve is closed, suction on the spring-loaded diaphragm charges the acceleration pump. When the throttle is opened, the acceleration pump discharges fuel into the blower throat.

(b) REMOVAL.

1. Release the Dzus fasteners and remove the upper section of accessory cowling on the outboard side.

2. Disconnect the Neoprene sleeve which extends from the carburetor to the air duct.

3. Remove the carburetor air scoop. (Refer to paragraph *6.c.*(1)*(c)2.*, and *c.*(1)*(d)2.*, this section.

4. Disconnect the throttle and mixture control rods at the carburetor.

5. Disconnect all lines which are connected to the carburetor.

6. Remove the nuts which secure the carburetor to the studs on the blower housing and lift the carburetor free.

(c) MAINTENANCE.—The following maintenance operations can be performed in the field without the use of a flow bench or overhaul equipment. It is not advisable to perform any further work on carburetors between overhaul periods. All work on carburetors should be done by specialists in this work.

1. Remove the fuel strainer bolt, cap, and strainer from the regulator body and clean the parts. Inspect the vent float, needle, and seat. Be sure the fuel strainer is put in the fuel strainer housing with the recessed end (into which the spring fits) toward the outside or housing cover.

2. Mixture control and idle linkage joints should be examined occasionally for play. Link bolts, with spring washers in place, should be tightened securely.

3. The automatic mixture control unit may be removed for inspection or replacement. While this unit is removed, clean the needle valve.

CAUTION

When the automatic mixture control is removed, particular care must be taken not to change the position of the adjusting screw and lock nut.

4. Keep the boost venturi clean at all times. Clean the impact tubes with pipe cleaners or a small wire.

5. When making connections between the fuel pump and the carburetor, be sure to clean all sealing compound off the ends of the connections. Use the sealing compound lightly on the threaded area only.

6. Make frequent checks for broken lock wires, loose nuts and plugs.

(d) INSTALLATION. — A recommended procedure for the installation of the carburetor on all C-47 type airplanes follows:

1. Fit the carburetor over the studs on the blower housing, without gasket, and tighten the hold-down nuts.

2. Connect all lines leading to the carburetor.

3. Connect the throttle and mixture control rods at the carburetor.

4. Install the carburetor air scoop. Refer to *6.c.*(1), preceding.

5. Install the neoprene sleeve which connects the carburetor to the air duct.

6. Install the sections of the accessory cowling which have been removed.

(e) ADJUSTMENTS.

1. CARBURETOR IDLE ADJUSTMENT.—When a carburetor is once set for proper idling it does not ordinarily require readjustment except to correct for wide variations in weather conditions. An idling adjustment which has been satisfactory for an engine should not be changed until all other possible causes of unsatis-

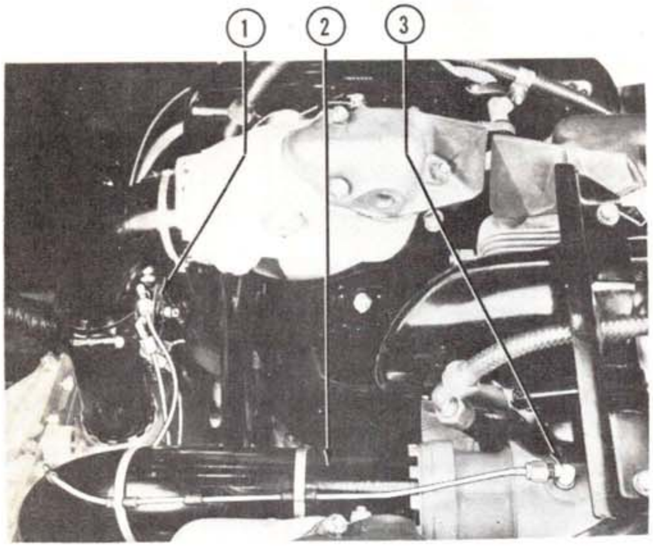


Figure 221—Cylinder Priming Lines

1. Primer Spider
2. Cylinder Inlet Line and Priming Line (Small)
3. Primer Inlet Connection

factory idling have been investigated. If it is necessary to reset the idle adjustment, it should be done in the following manner:

a. Start the engine and run it at approximately 1000 rpm until the oil temperature reaches 140°F (60°C) to 158°F (70.5°C) and the cylinder head temperatures are normal.

b. Run the engine up to 2000 rpm and check the spark plugs by operating on each magneto separately. If the drop-off in rpm is excessive, check for fouled plugs.

c. Slow down to closed throttle, 450 rpm. Adjust the throttle stop if the engine does not idle at approximately this rpm.

d. Move the control into "IDLE CUT-OFF" and observe the rise or fall in rpm. Move the control back into "AUTO RICH" before the engine stops. If the idling adjustment is properly set at 450 rpm, there will be a slight rise not in excess of 10 rpm.

e. If the engine rpm *decreased* immediately when the control was moved to idle cut-off, turn the knurled idle adjusting screw one or two notches in a clockwise direction to enrich the mixture and again check the rpm.

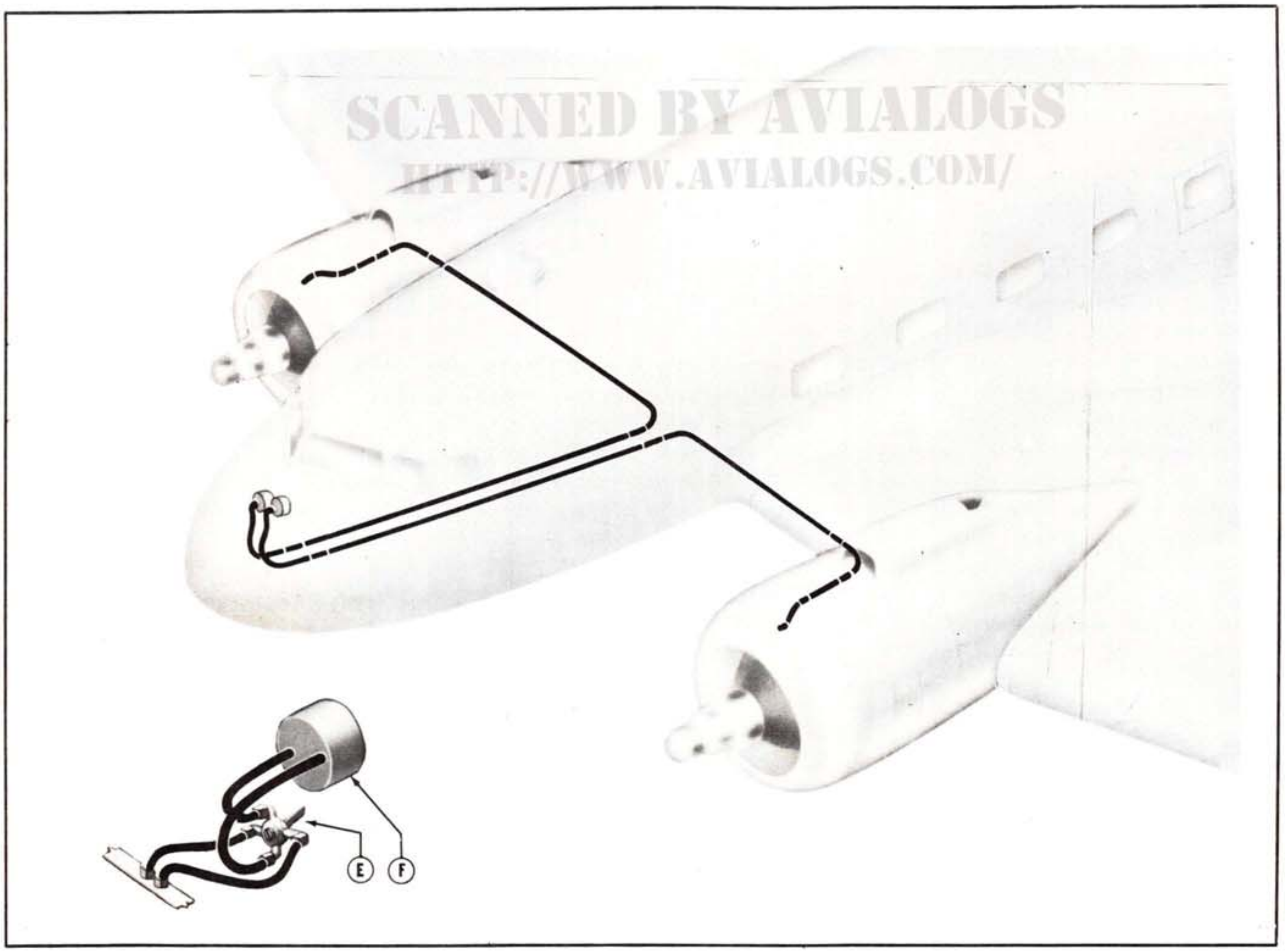


Figure 222—Manifold Pressure System

E. Manifold Pressure Instrument (See instrument table. paragraph 11, this section) F. Manifold Pressure Valve.

f. If the engine rpm *increased* momentarily by more than 10 rpm when the mixture control was moved to "IDLE CUT-OFF," lean the mixture slightly by turning the knurled idle adjusting screw one or two notches in a counterclockwise direction; then move the control to "IDLE CUT-OFF" and check the rpm.

g. Each time the adjustment is changed, run the engine up to 2000 rpm to clear the spark plugs before proceeding with the check.

h. To dissipate the heat caused by repeatedly running up the engine, allow the engine to idle (450 rpm) for five minutes before making the final decision on adjustment. Make the check in relatively still air. If this is impossible, place the airplane crosswind. A strong wind affects propeller loading and the rpm change may be different from that noted previously.

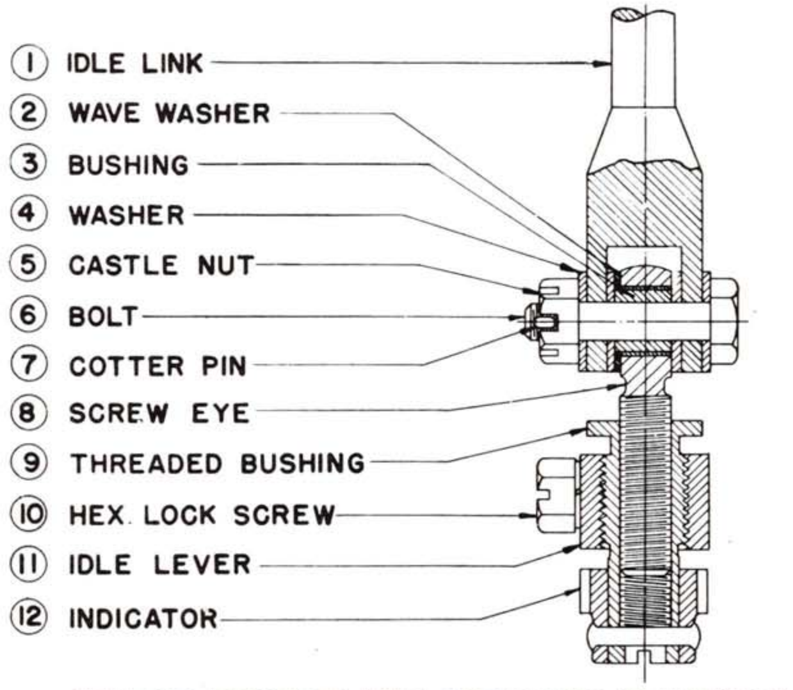
i. Repeat the foregoing procedure until a momentary increase not in excess of 10 rpm is noted when the mixture control is moved to "IDLE CUT-OFF." When this condition exists, the idling adjustment is satisfactory.

j. When the idling has been properly adjusted, tighten and lockwire the idle mixture adjustment lock screw.

k. In case there is insufficient travel of the idle mixture adjustment to obtain the correct idle mixture, disconnect the idle link (1, figure 222A) from the screw eye (8, figure 222A) by removing the link bolt (6, figure 222A). Then turn the screw eye (8, figure 222A) into the threaded bushing (9, figure 222A) if leaner mixtures are required, or out of the bushing if richer mixtures are desired. One revolution of the screw eye is equivalent to approximately 13 notches of the mixture adjustment indicator (12, figure 222A). Reconnect the idle link (1, figure 222A) with extreme care to be certain that the various parts are in their correct positions. The four plain washers (4, figure 222A) should be in the positions shown. The spring wave (2, figure 222A) must be carefully placed so that it fits over the outside diameter of the bushing (3, figure 222A) and so it is next to the screw eye. The castle nut (5, figure 222A) must be tightened enough to allow the yoke of the idle link (1, figure 222A) and plain washers (4, figure 222A) to clamp the bushing (3, figure 222A) tightly in place so it cannot move on the bolt (6, figure 222A). If the castle nut (5, figure 222A) is not tightened sufficiently, the clearance between the inside diameter of the bushing (3, figure 222A) over the outside diameter of the bolt (6, figure 222A) will allow enough play in the linkage to cause inconsistent engine idling.

2. OTHER ADJUSTMENTS.—All other adjustments should be made only at a major depot where a flow bench is available.

(3) ENGINE PRIMER SYSTEM.—When the engine primer solenoid (paragraph 10.*h.*(1)*(b)*, this section) is energized, fuel flows under pressure to a spider fitting (figure 221) mounted on the intake pipe of cylinder 1. The spider fitting is a distribution reservoir with eight outlets. Small lines connect from these outlets to the top eight cylinders and distribute the fuel to these cylinders for priming.



SECTION THROUGH IDLE ADJUSTING MECHANISM

Figure 222A—Diagram of Idle Adjustment Mechanism

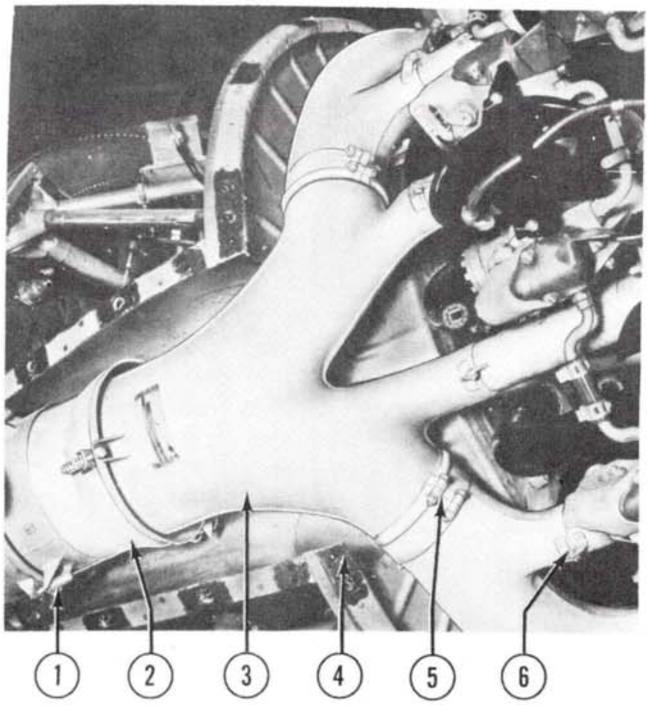


Figure 223—Exhaust Collector Ring Installed

1. 2001405 Clamp Assembly
   Consists of: AN4-13 Bolt; AN310-4 Nut; 117425-47-016 Bushing
2. 2115059 Telescoping Flange
3. Main Segment (See Douglas Drawing No. 5115224)
4. Engine Diaphragm
5. S2001405 Clamp Assembly (See Douglas Drawing No. 5115224)
6. AN393-11 Clevis Pin; AN960-10 Washer

(4) MANIFOLD PRESSURE.—A diagram of the manifold pressure system is shown in figure 222. The function of this system is to measure the pressure at which the fuel mixture enters the intake pipes of the engine. The control and the dual gage are located on the instrument panel of the airplane.

(5) EXHAUST SYSTEM.

(a) COLLECTOR RING. *(See figure 224.)*

1. DESCRIPTION. – The exhaust collector ring is a welded corrosion-resistant steel assembly made in seven sections, each section collecting exhaust from two cylinders. The sections are of graduated size; the small sections are on the inboard side and the largest sections are on the outboard side at the point where the tail pipe connects to the collector ring. Each section of the collector ring is bolted to a stand-off bracket on the blower section of the engine and further supported by a sleeve connection between the collector ring ports and the "short stack" on the engine exhaust ports. The tail pipe is joined to the collector ring by a telescoping expansion joint. This telescoping joint allows enough play to make it possible to remove the segments of the collector ring without removing the tail pipe.

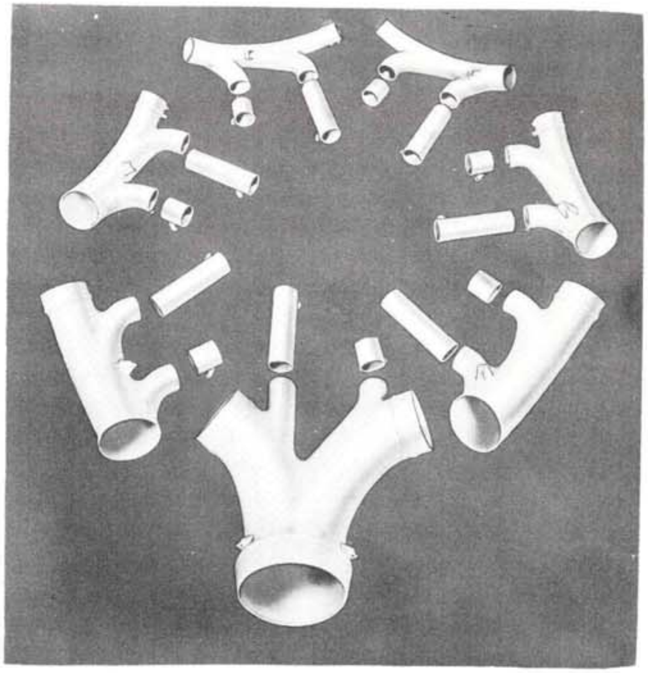


Figure 224—Exhaust Collector Ring Disassembled

2. REMOVAL.

a. Remove the accessory cowling by releasing the Dzus fasteners.

b. Remove the upper and lower clamp from between the main exhaust unit (to which the tail pipe attaches) and the collector ring segments on either side of the unit.

c. Disconnect the main exhaust unit from the engine blower case brace bracket.

d. Remove the cotter and pin from the attach point on the sleeve between the collector ring port and the two engine exhaust ports.

e. Remove the three spring-loaded bolts from the forward connection of the telescoping expansion joint on the tail pipe.

f. Pull the main exhaust unit back to clear the "short stack" on the engine exhaust ports and then drop the unit clear of the engine.

g. Remove the six remaining segments of the exhaust collector ring by disconnecting each segment from its engine blower case brace and removing the cotter and pin from the connection on the sleeves between the collector ring and the engine exhaust ports. When these two connections are free, each segment can be pulled free and removed.

3. MAINTENANCE.

a. Examine the exhaust collector ring, mounting lugs, and tail pipe for cracks or excessive burning.

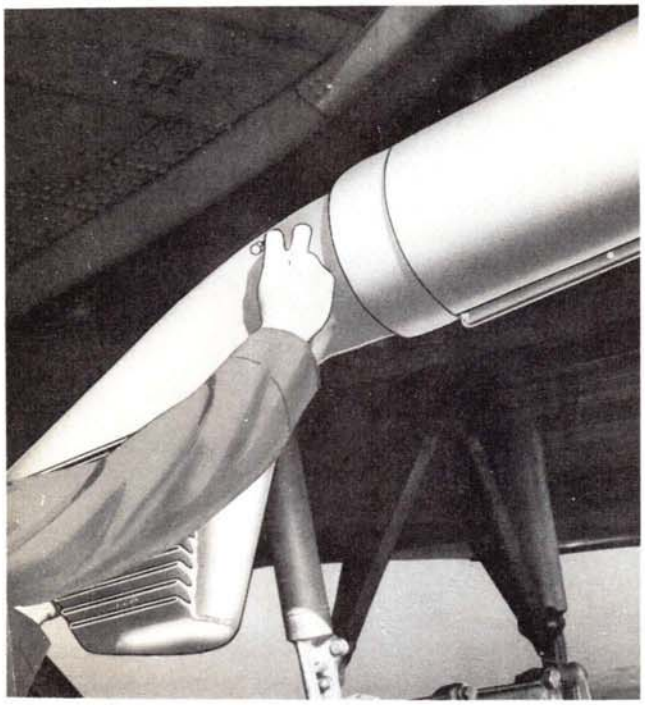


Figure 225—Flame Dampener Installed

b. Small cracks, holes, or other damage of a minor nature may be repaired by welding.

4. INSTALLATION.—The exhaust collector ring may be installed by reversing the removal procedure.

(b) EXHAUST TAIL PIPE.

1. DESCRIPTION.—The exhaust tail pipe is a welded corrosion-resistant steel assembly, consisting of the exhaust pipe and a muff-type heat exchanger. (See section IV, paragraph 18.*c*.(2).) On airplanes equipped with the steam-type heating system, the muff-type heat exchanger is not installed. Instead, a boiler is installed in the right tail pipe assembly.

2. REMOVAL.—Remove the bolts from the brackets and links and lift the tail pipe-heat exchanger assembly out.

3. MAINTENANCE REPAIR OR REPLACEMENT.—The tail pipe and muff-type heat exchanger assembly should be replaced rather than repaired.

4. INSTALLATION. *(See figure 223.)*

a. Secure the extreme aft adjustable link to the applicable bracket and place a bolt through the bracket holes and link head and tighten the nut against the bracket.

b. Secure the side adjustable links in the same way.

c. Insert the flange projection on the top forward end of the heat exchanger between the projections of the proper bracket and insert a pin through the three aligned holes.

d. Secure the lower flange projection to the proper bracket and insert a bolt through the three aligned holes.

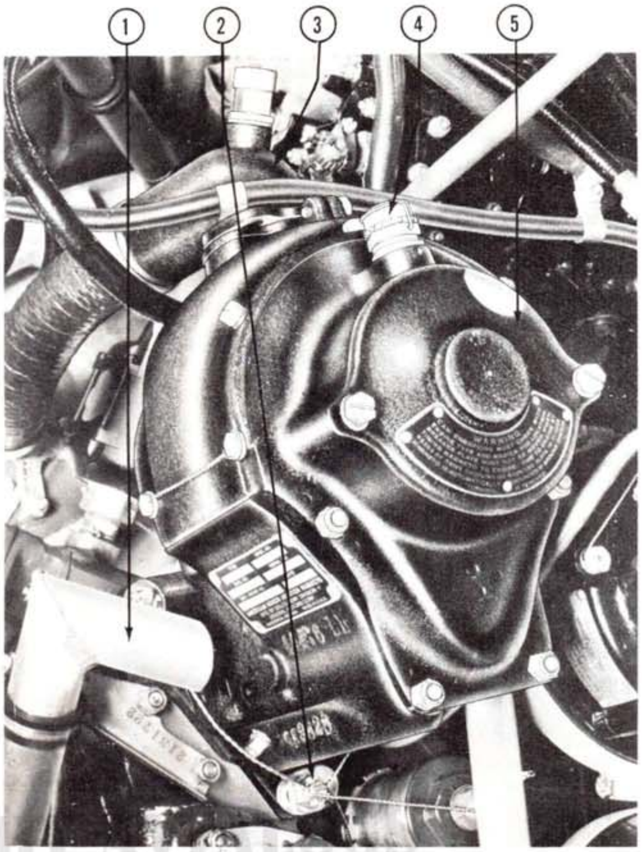


Figure 226—Magneto Installed

1. Magneto Blast Tube
2. Mounting Flange
3. Ignition Conduit to Spark Plugs
4. Ground Connection
5. Breaker Housing Cover

e. Remove the pin from the flange projection on the top forward end of the heat exchanger and replace the pin with an AN4-12A bolt. Five AN960-416 steel washers should fit on the bolt between the flange and the side of the bracket.

f. Secure the middle top adjustable link as described in a., preceding.

(c) FLAME DAMPENER. *(See figure 225.)*—Two flame dampeners are shipped with the airplane as loose items. These dampeners are made to fit over the end of the tail pipe and are used to diminish the visibility of the exhaust flame in night flying. The flame dampeners may be installed by slipping the flame dampener over the end of the tail pipe and fastening it in place by screwing bolts into the nut plates built into the exhaust tail pipe.

d. ENGINE IGNITION.

(1) GENERAL.—The ignition system includes ignition switches, booster coil (C-47) or induction vibrator (C-47A), magnetos, ignition harness, and spark plugs. The ignition circuit may be disconnected at the fire wall. Since removal of this plug leaves the igni-

tion system "ON," care should be taken that the propeller is not moved. The ignition may be completely grounded by disconnecting the system at the magneto. The ignition switch in the pilots' compartment has a master switch for the entire system as well as left and right switches for each engine. The two magnetos installed on the rear accessory section of each engine distribute the current to the spark plugs through the ignition wiring and harness. On C-47 airplanes a booster coil is provided which furnishes high-tension current for starting. On C-47A airplanes, an induction vibrator is installed in place of the booster coil. (See paragraph 8, this section.) For starting and stopping engines refer to paragraph 6., section III.

(2) MAGNETOS.

(a) DESCRIPTION.—Ignition is furnished to the spark plugs by two magnetos (figure 226) mounted on the engine rear accessory section. The right magneto fires the front spark plugs of all cylinders and the left magneto fires the rear spark plugs. Three types of magnetos have been used, SF14LN-3 (Scintilla), SF14LU-7 and SF14LU-8 (American Bosch). Any one of these types may be used, but it is not advisable to use two different types on the same engine. The magnetos may be used on either right or left sides if the radio shield assembly with the correct outlet is used. All three are single-type, flange mounted magnetos. Rotation is counterclockwise, as viewed from the drive shaft end of the magneto. On C-47 airplanes, both magnetos have grounding leads from the ignition switch and send current into the ignition harness. The outboard magnetos only connect to the booster coil. On C-47A airplanes, the ignition switch leads connect with the left magneto and the induction vibrator. The induction vibrator then connects to the right magneto.

CAUTION

> The ignition is grounded through a plug on the forward face of each fire wall and removal of this plug leaves the ignition "ON." Therefore, service personnel should take precautions to see that the propeller is not pulled through when the engine is warm and the ignition plug is disconnected. A warning decal reading—"DANGER—WITH IGNITION PLUG OUT, IGNITION IS ON," is located adjacent to the ignition plug on each fire wall. When self-grounding plugs are installed, the warning decal is unnecessary.

(b) REMOVAL.

1. Disconnect ignition leads at magneto. This grounds the magneto internally.

2. Disconnect all electrical connections.

3. Cut safety wire and remove the nuts which hold the magneto to the engine rear section.

4. When removing and replacing distributor blocks, care should be taken that the carbon brush in the center of the block is not broken. Use the following instructions:

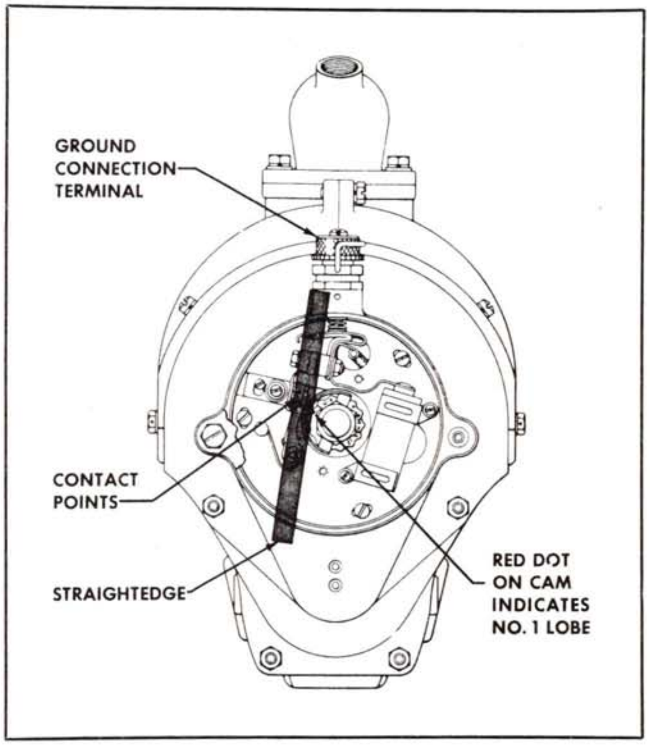

GROUND CONNECTION TERMINAL
CONTACT POINTS
STRAIGHTEDGE
RED DOT ON CAM INDICATES NO. 1 LOBE

Figure 227—Breaker Assembly (American Bosch Magneto)

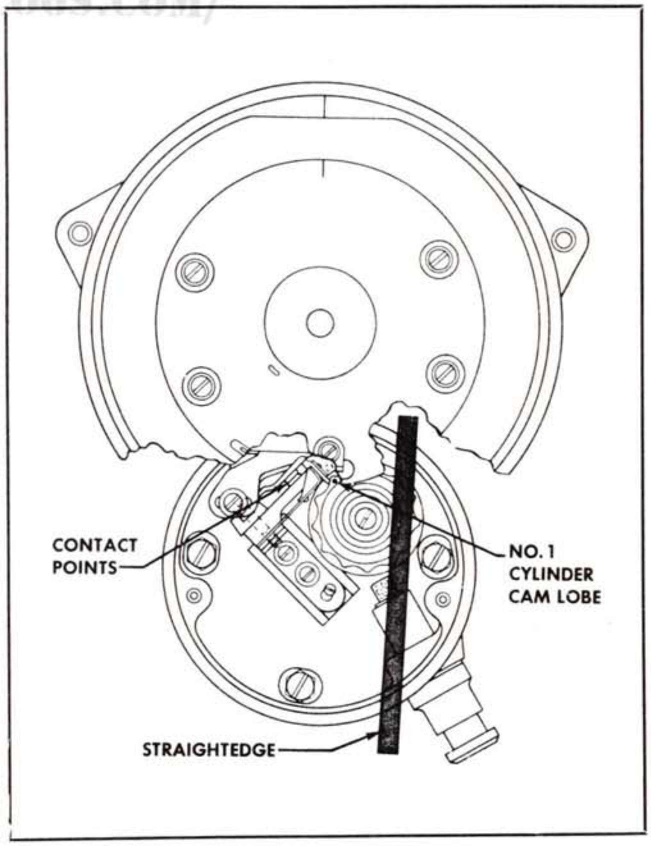


Figure 228—Breaker Assembly (Scintilla Magneto)

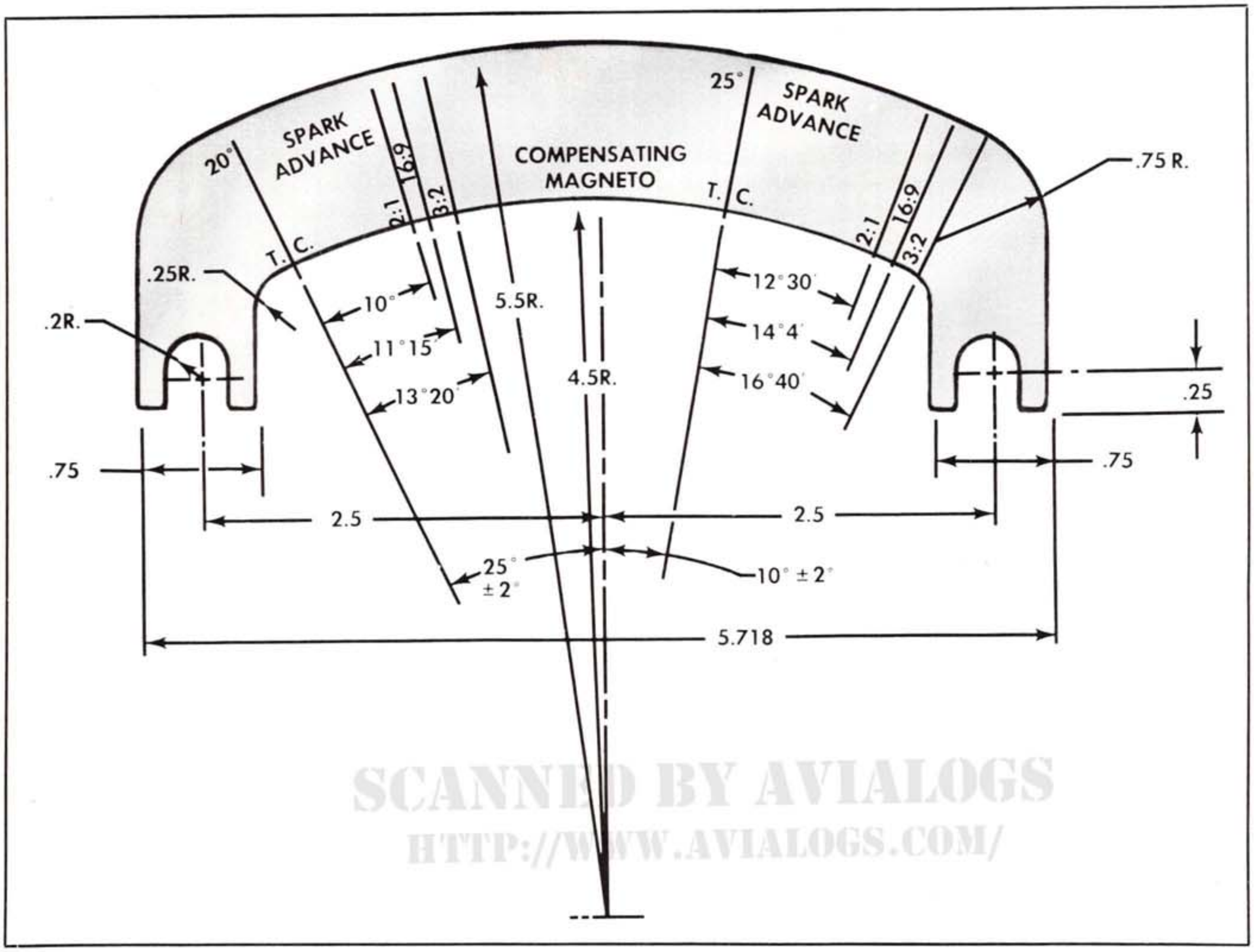


Figure 229—Ignition Timing Template

a. Remove the two screws that keep the wire manifold elbow from turning and lift the elbow off as much as necessary. Remove the knurled connection if a booster coil is used. Remove forward coil cover before removing blocks.

b. At removal, the cover screws are loosened and the block moved vertically a short distance until it is possible to tilt the block backwards and keep the carbon brush away from the edge of the front case of the magneto.

c. At replacement, the block is tilted backward and inserted in the magneto until the carbon brush has cleared the forward case of the magneto. Care should be taken to see that the insulation of the ignition wires is not damaged while the knurled connection is loose.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. RECONDITIONING CONTACT BREAKER POINTS. *(See figures 227 and 228.)*—Unless the contact breaker points are oily, dirty, or badly pitted, do not disturb them. If it is necessary to clean the contact points, use approved solvent. Do not use emery cloth, file, or sandpaper.

CAUTION

When opening the breaker contact points for inspection or to insert the feeler strips, do not raise the main spring more than 1/16 inch. Further opening will weaken the spring.

2. No lubrication is required between overhauls.

(d) INSTALLATION.

1. Remove the front spark plug of cylinder 1 and insert a top dead center indicator.

2. Remove rocker box covers for cylinder 1.

3. Install the timing template (figure 229) onto the nose case.

4. Use a timing pointer or wrap a piece of stiff wire around the propeller hub or shaft and line it up with the timing template.

5. Determine the compression stroke by making sure that both the intake and exhaust valves are closed.

6. Turn the propeller shaft until piston 1 is at the top of its compression stroke (top dead center indicator just stops moving downward).

7. Set timing pointer to 0 degrees or top center of timing template.

8. Continue to turn propeller shaft in direction of normal rotation until piston just starts to move down (top dead center indicator just starts to move upward).

9. Check the movement of the timing pointer from the top center mark on the timing template. To obtain true top dead center, move the pointer half the distance back to the top center (0-degree) mark.

10. Move the propeller shaft 90 degrees in direction opposite to normal rotation.

11. Move propeller shaft in direction of normal rotation until timing pointer indicates correct position on the timing template for firing cylinder 1.

12. At this point, the engine is set correctly for magneto removal or installation.

13. For installation procedure, turn the magneto drive shaft until a straight edge placed across the flat step on the cam lines up with the scribed timing marks on the rim of the breaker housing, (See figures 227 and 228.)

14. Hold the cam in this position and install the magneto to the engine with the engine studs in the center of the elongated slots.

15. USE THE FOLLOWING STEPS FOR SF14LN-3 (SCINTILLA) MAGNETOS ONLY.

a. Mount the magneto on the engine with the adjusting studs in the center of the slots in the mounting flange.

b. If the magneto will not mount in this position, remove the spline coupling from the end of the magneto drive shaft and reinstall in another position. It is possible to obtain six different spline alignment positions without changing the presetting of the magneto.

16. USE THE FOLLOWING STEPS FOR SF14LU-7 AND -8 (AMERICAN BOSCH) MAGNETOS.

a. Mount the magneto on the engine with the adjusting studs in the center of the elongated slots in the mounting flange.

b. If the magneto and engine splines will not match in this position, turn the magneto drive shaft until the cam has made one complete revolution. Realign the step on the cam with the scribed timing marks on the rim of the cam housing.

c. If the magneto cannot be installed in this position, repeat the preceding step. This procedure may be repeated four times, each time obtaining a different spline relationship between the magneto drive shaft and the engine magneto drive gear.

17. When the splines line up and the magneto is placed on the mounting flange, install the three nuts and washers to finger tightness.

18. For synchronized spark requirements, the contact points of both magnetos must open at the same instant within close limits. Use a timing light to determine the opening of the contacts.

19. Avoid the use of feeler strips between the contact points, since there is a possibility that oil and dirt on the strips, or particles of the strips, will foul the points.

20. When synchronization has been made, secure the magneto firmly by tighting all cap screws or lock nuts.

(e) The following procedure is an alternate method for positioning the No. 1 piston 25 degrees before top center in order to time and synchronize the magnetos, using a (Time-Rite) PWA-4142 indicator:

1. Turn the propeller shaft in the normal direction of rotation to bring the No. 1 piston to the beginning of the compression stroke.

2. Install PWA-4142 indicator in the front spark plug hole of Cylinder No. 1. (See figure 229A.)

3. Align the cap of the indicator so that the slide slot is aligned with the vertical axis of the cylinder and the pivot arm is at the top of the slot. Push the slide pointer up close to the pivot arm. (See figure 229B.)

4. Turn the propeller shaft in the normal direction of rotation until the pivot arm pushes the slide pointer to its farthest point. (See figure 229C.)

5. Turn the propeller shaft about 90 degrees in the opposite direction. This will return the pivot arm to the top of the slot.

6. Adjust the proper engine scale (the scale marked R-1830) so that the zero degree mark on the scale aligns with the reference mark on the slide pointer. (See figure 229D.)

7. Move the slide pointer up to align with the 25 degree mark on the scale. (See figure 229E.)

8. Turn the propeller shaft in the normal direction of rotation until the pivot arm just contacts the slide. At this point the lower light on the indicator should flash on. The No. 1 piston is now positioned 25 degrees before top center.

(3) IGNITION HARNESS AND WIRING.

(a) DESCRIPTION.—A Pratt & Whitney, radio-shielded ignition harness is installed on the nose section of each engine. The harness carries electrical leads from the distributor blocks to the spark plugs in each cylinder. The numbers on the distributor blocks show the serial

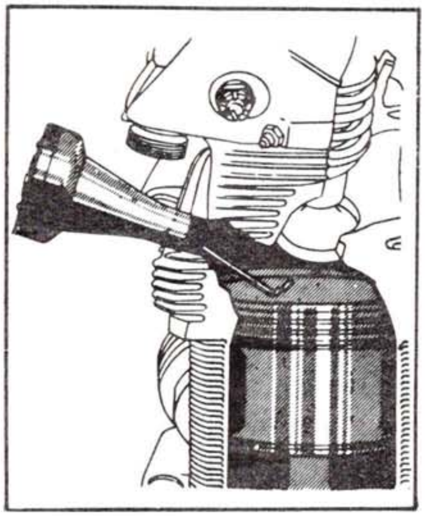


Figure 229A—(Time-Rite) PWA-4142 Indicator Installed in Cylinder

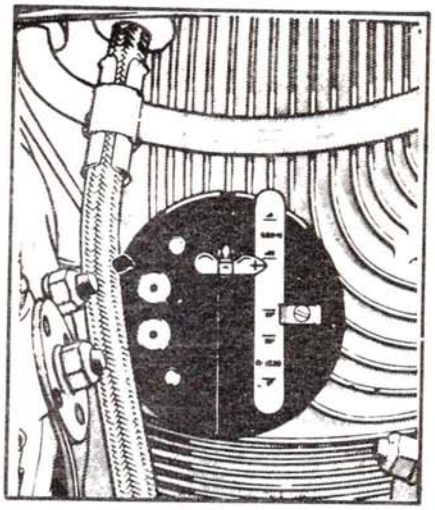


Figure 229B—Indicator Pointer Against the Pivot Arm

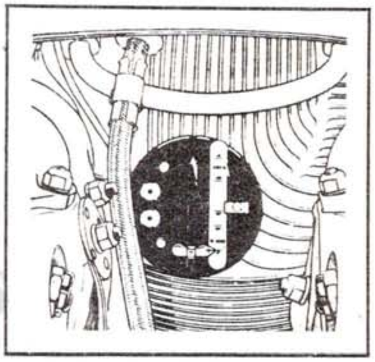


Figure 229D—R-1830 Scale Correctly Adjusted

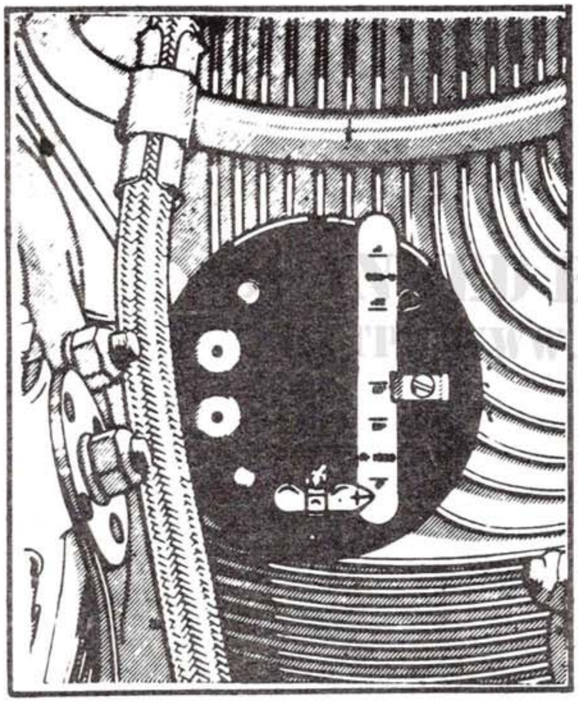


Figure 229C—Indicator Pointer Showing Farthest Limit

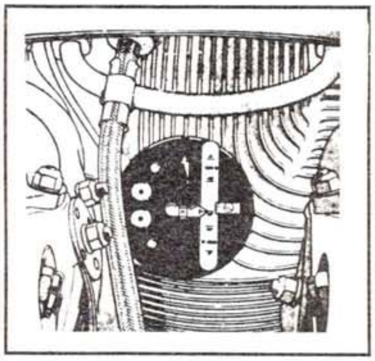


Figure 229E—Pointer Indicating 25 Degrees Before Top Center

firing order of that engine. Each magneto is wired so that No. 1 wire on the distributor block goes to the first cylinder on the firing order (cylinder 1). No. 2 wire on the distributor block goes to the second cylinder in the firing order (cylinder 10). This procedure continues through the entire firing order which is: 1-10-5-14-9-4-13-8-3-12-7-2-11-6.

(b) REMOVAL OF IGNITION MANIFOLD ASSEMBLY.

Note

It will be necessary to remove No. 2 and No. 12 cylinders before the ignition manifold assembly can be removed from the engine.

1. Remove No. 2 cylinder first, then No. 12, and secure the master rod in the center of the crankcase opening so it cannot move sideways.

2. Unfasten the clamps holding the conduit to the blower case and the cylinder pads of No. 14, No. 4, No. 11, and No. 1 cylinders.

3. Unfasten the two clamps which hold the manifold to the front crankcase.

4. Loosen the knurled nut holding the conduit to the manifold and lift the manifold from the engine, turning the conduit as it passes between the cylinders.

(c) MAINTENANCE.

1. Examine the ignition harness installation for security of mounting and chafing of the flexible conduits.

2. Replace a damaged wire (figure 230) in the following manner:

a. Remove the spark plug sleeve and conduit.

NO. OF MAGNETO BLOCK	CYLINDER FIRING ORDER NO.	TOTAL LENGTHS REAR	FRONT
1	1	87	72
2	10	87	93
3	5	103	73
4	14	80	72
5	9	91	98
6	4	95	63
7	13	78	80
8	8	89	79
9	3	94	65
10	12	76	82
11	7	110	83
12	2	89	66
13	11	87	89
14	6	106	75

FOR LONG NECK MAGNETOS, ADD 1⅓ INCHES TO GIVEN LENGTH

MODEL NUMBER	*TYPE*
SF14LN - 4	LONG NECK
SF14LU - 7	LONG NECK
SF14LN - 3	SHORT NECK

Figure 230—Ignition Wire Lengths

b. Remove the wire from the distributor block.

c. Loosen the large conduit nut and slide the conduit slightly toward the magneto.

d. Determine whether it will be easier to pull the wire out of the spark plug end or the magneto end.

e. Splice and solder a new wire to the opposite end of the old wire.

f. Lightly coat the new wire with Dow-Corning compound No. 4.

g. Pull the old wire out and at the same time feed the new wire into the harness.

h. Particular care should be taken to insure that the insulation on the new wire is not damaged as it enters the harness.

i. Take particular care when installing the spring connecting sleeves to the spark plug end of the wire. Cut away enough insulation to permit the central wire core to extend through the wire outlet 1/8 inch.

j. Install the sleeves and bend the wire of the central core back over the wire opening.

k. After the sleeves are installed, wipe them clean. Any dirt, grease, acid, or scratches left on these surfaces greatly reduces flash-over voltage and may result in damage to the sleeve and faulty operation.

l. After the wiring manifold has been assembled, use some form of standard electrical test to

KEY TO FIGURE 231

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2116128	Bell Crank	2
2	2116168	Rod Assembly	2
	Each Consists of:		
	2116168	Tube	1
	149992-A	Rod End	1
	1116214	Clevis	1
	AN316-4R	Nut	1
	AF33A6241	Rod End	1
3	2116134-1	Throttle Lever RH	1
	Consists of:		
	1116207-1	Knob	1
	2116134-3	Lever	1
4	2116134	Throttle Lever LH	1
	Consists of:		
	1116207	Knob	1
	2116134-2	Lever	1
5		Clevis and Clevis Pin Connection	
6	2085485A-1608	Rod Assembly	2
	Each Consists of:		
	2085485A-1608	Rod	1
	RE4F5	Fafnir Bearing Rod End	2
	AN316-5R	Nut	2
	Attached by:		
	AN4-12	Bolt	2

KEY TO FIGURE 231 (Continued)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
	AN310-4	Nut	2
7	1113392	Bell Crank	1
8	2032516A-1300	Rod Assembly	1
	Consists of:		
	2032516A-1300	Rod	1
	AF33A6241	Rod End	2
	AN316-4R	Nut	2
	Attached by:		
	AN3-10	Bolt	2
	AN310-3	Nut	2
9	1117720-1	RH Bell Crank	1
	1117720	LH Bell Crank	1
	Cables attached by:		
	AN393-9	Pin	4
10	4114029-23	RH Throttle Cable Assembly	1
	Consists of:		
	4114029-1	Cable	1
	4114029-22	Cable	1
	AN155-16L	Turnbuckle	1
11	4114029-25	RH Throttle Cable Assembly	1
	Consists of:		
	4114029-1	Cable	1
	4114029-24	Cable	1
	1203473	Turnbuckle	1
12	4114029-11	LH Throttle Cable Assembly	1
	Consists of:		
	4114029-1	Cable	1
	4114029-10	Cable	1
	1203473	Turnbuckle	1
13	4114029-13	LH Throttle Cable Assembly	1
	Consists of:		
	4114029-1	Cable	1
	4114029-12	Cable	1
	1203473	Turnbuckle	1
14	2032516A-2500	Rod Assembly	1
	Consists of:		
	2032516A-2500	Rod	1
	AC33A6241	Rod End	2
	AN316-4R	Nut	2
	Attached by:		
	AN3-10	Bolt	2
	AN310-3	Nut	2
15	1113391	Bell Crank	1
16	2115277-8	RH Throttle Cable—Pedestal to Main Cable	1
17	2115277-6	RH Throttle Cable—Pedestal to Main Cable	1
18	2115277-2	LH Throttle Cable—Pedestal to Main Cable	1
19	2115277-4	LH Throttle Cable—Pedestal to Main Cable	1

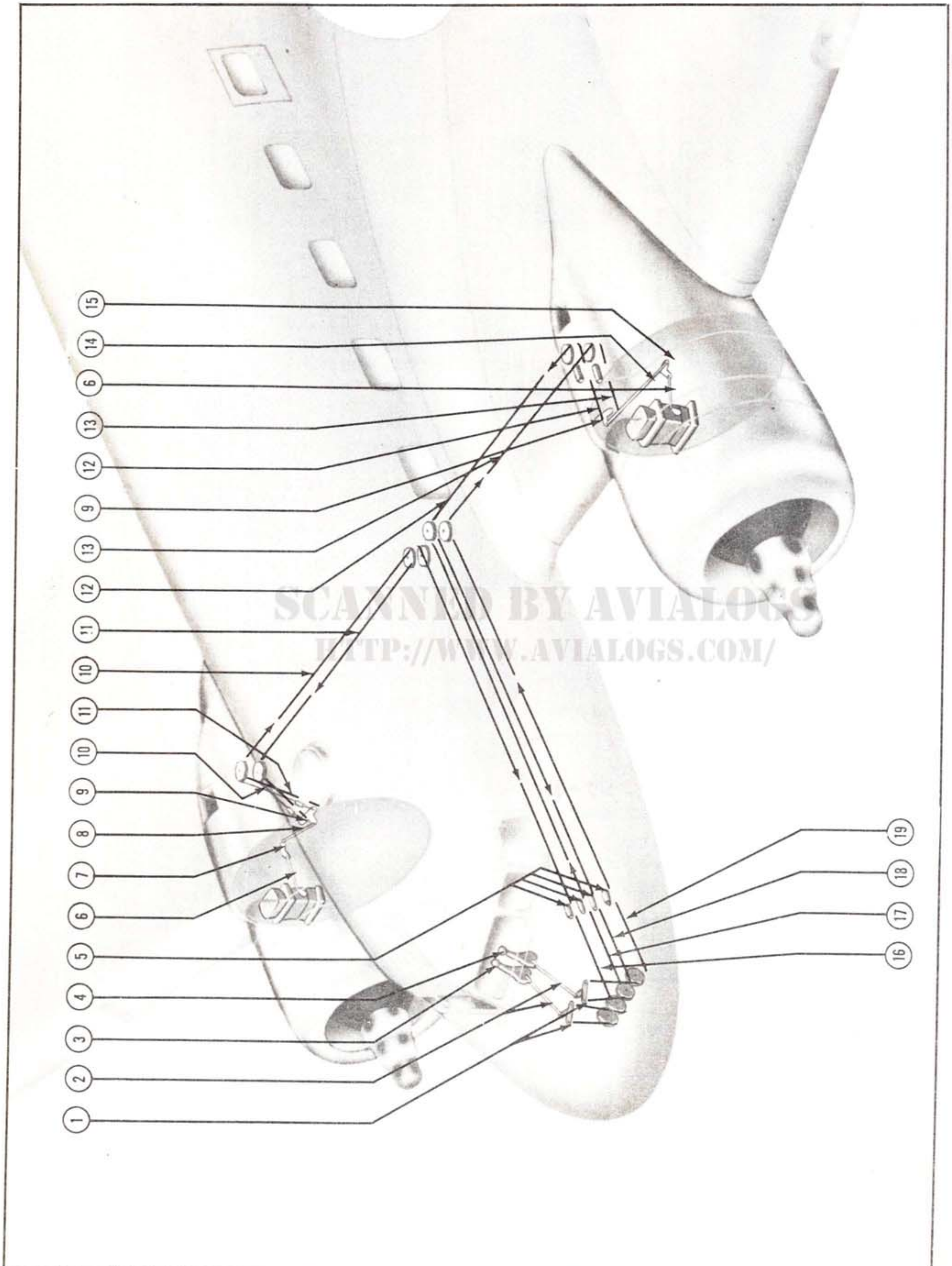

1
2
3
4
5
6
7
8
9
10
11
10
11
12
13
9
12
13
6
14
15
16
17
18
19

Figure 231—Throttle Control System

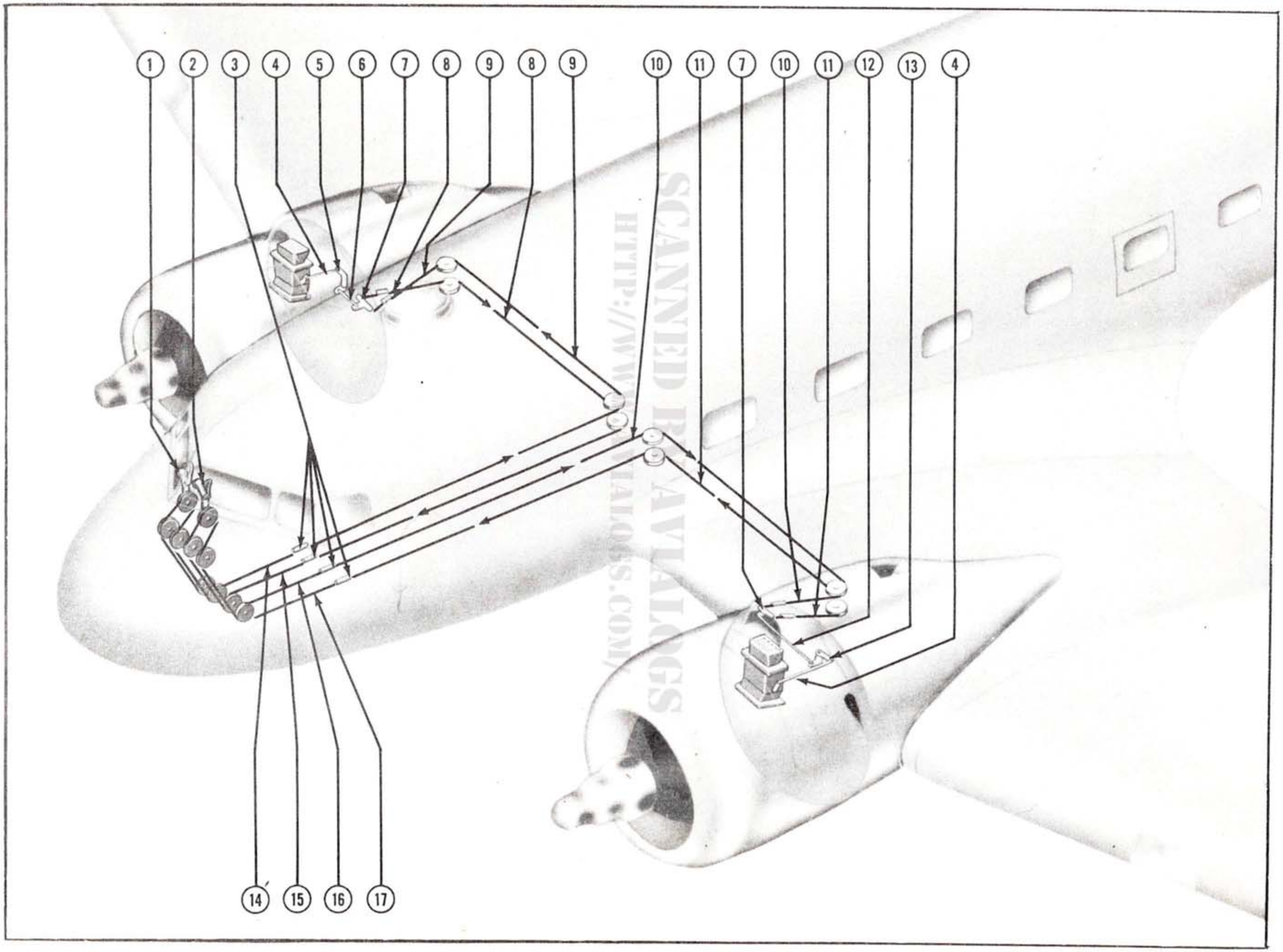

1
2
3
4
5
6
7
8
9
8
9
10
11
7
10
11
12
13
4
14
15
16
17

Figure 232—Mixture Control System

KEY TO FIGURE 232

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	4115346	Lever Assembly LH	1
	Consists of:		
	2116136	Lever Assembly	1
	2116137	Latch Lever	1
	1116212	Latch Spring	1
	AN392-15	Pin	1
	1116231	Knob	1
	1116210	Link	1
	1116217	Latch Connector	4
	1116218	Latch Screw	1
	1116233	Latch	1
	AN392-27	Pin	1
	AN392-23	Pin	1
	2116132	Drum	1
	4115346-2	Cable Assembly (See Item 9)	1
2	4115347	Lever Assembly RH	1
	Consists of:		
	2116135	Lever Assembly	1
	2116137	Latch Lever	1
	1116229	Knob	1
	1116212	Latch Spring	1
	AN392-17	Pin	1
	1116211	Link	1
	1116217	Latch Connector	4
	1116218	Latch Screw	1
	1116233	Latch	1
	AN392-27	Pin	1
	AN392-23	Pin	1
	2116132	Drum	1
	4115347-2	Cable Assembly (See Item 10)	1
3		Clevis and Clevis Pin Connection	
4	2085485A-908	Rod Assembly	2
	Each Consists of:		
	2085485A-908	Rod	1
	RE4F5	Fafnir Rod End	2
	AN316-5R	Nut	2
	Attached by:		
	AN4-13	Bolt	1
	AN310-4	Nut	2
	AN4-12	Bolt	1
5	4113270	Bracket Assembly RH	1
	Consists of:		
	4118259	Bracket	1
	1114528	Arm	1
	117425-8D-008	Spacer	1
	K8A	Fafnir Bearing	2
	1113521	Lever	1
	1118257	Shaft	1
	AN310-5	Nut	1
	124604-10-10	Taper Pin	2
	AF365D682	Nut	2
	Attached by:		
	AN3-6A	Bolt	8
	AF365-1032	Nut	8

KEY TO FIGURE 232 (Continued)

Item	*Part No.*	*Part Name*	*No. Req PerApl*
6	2032516A-1620	Rod Assembly	1
	Consists of:		
	2032516A-1620	Rod	1
	AF33A6241	Rod Ends	2
	AN316-4R	Nut	2
	Attached by:		
	AN3-10	Bolt	2
	AN310-3	Nut	2
7	1117721	Bell Crank	2
	Cables attached by:		
	AN393-9	Pin	4
8	4114029-21	RH Mixture Cable Assembly	1
	Consists of:		
	4114029-20	Cable	1
	4114029-1	Cable	1
	1203473	Turnbuckle	1
9	4114029-19	RH Mixture Cable Assembly	1
	Consists of:		
	4114029-18	Cable	1
	4114029-1	Cable	1
	1203473	Turnbuckle	1
10	4114029-9	LH Mixture Cable Assembly	1
	Consists of:		
	4114029-8	Cable	1
	4114029-1	Cable	1
	1203473	Turnbuckle	1
11	4114029-7	LH Mixture Cable Assembly	1
	Consists of:		
	4114029-6	Cable	1
	4114029-1	Cable	1
	1203473	Turnbuckle	1
12	2032516A-2324	Rod Assembly	1
	Consists of:		
	2032516A-2324	Rod	1
	AF33A6241	Rod End	2
	AN316-4R	Nut	2
	Attached by:		
	AN3-10	Bolt	2
	AN310-3	Nut	2
13	4113270-1	Bracket Assembly LH	1
	Consists of:		
	4118259-1	Bracket	1
	1114528	Arm	1
	117425-8D-008	Spacer	1
	K8A	Fafnir Bearing	2
	1113521	Lever	1
	1118257	Shaft	1
	AN310-5	Nut	1
	124606-10-10	Taper Pin	2
	AF365-D682	Nut	2
	Attached by:		
	AN3-6A	Bolt	8
	AF365-1032	Nut	8
14	4115346-2	LH Mixture Cable (Ref Item 1)	1
15	4115346-2	LH Mixture Cable (Ref Item 1)	1
16	4115347-2	RH Mixture Cable (Ref Item 2)	1
17	4115347-2	RH Mixture Cable (Ref Item 2)	1

check the wiring against the wiring diagram. Repeat the electrical test to insure that the manifold has been wired properly.

(d) INSTALLATION OF IGNITION MANIFOLD ASSEMBLY.—Install the ignition manifold before No. 2 and No. 12 cylinders are installed.

1. Place the assembly in position on the engine by installing the left manifold conduit between No. 14 cylinder and No. 12 cylinder pad of the front row and between No. 11 and No. 13 rear row cylinders. Install the right conduit between No. 4 cylinder and No. 2 cylinder pad of the front row between No. 1 and No. 3 rear row cylinders.

2. Attach the left manifold conduit brackets to the first cylinder hold-down stud above the crankcase parting surface on No. 12 cylinder, to the first cylinder hold-down stud below the crankcase surface on No. 14 cylinder, and to the first cylinder hold-down stud below the parting surface on No. 11 cylinder. Attach the right manifold conduit brackets to No. 2, No. 4, and No 1 cylinders in the manner prescribed for the left manifold conduit brackets.

3. Install the No. 12 cylinder; then the No. 2 cylinder on the engine. Install the spark plug leads.

(4) SPARK PLUGS.

(a) DESCRIPTION.—Two spark plugs are installed in each of the 14 cylinders. The following five types are approved and may be used interchangeably in sets but should not be mixed: LS88, RC35S, C35S, SL2J, and SL2K. Indivdual leads extend from the distributor block of the magneto to each spark plug.

(b) REMOVAL.

1. Unscrew the nuts on the spark plug elbows and remove the ignition wire from the plug. Extreme care must be taken to see that the barrel is not rotated in the shell. *Use caution in removing elbow nuts as they are easily bent.*

2. Remove spark plugs with a standard spark plug socket wrench.

(c) MAINTENANCE OR REPLACEMENT.

1. Replace spark plugs after every 100 hours of engine operation, or sooner if necessary.

2. Inspect the ceramic insulation at the firing end of the spark plug and inside the barrel for cracks.

3. Check the center electrode for looseness.

4. Inspect the ⅞-inch hexagon nut for distortion.

5. Check both ends of the plug for damaged threads.

6. Spark plugs which fail to pass the above inspections must be discarded. Clean all grease and oil from plugs which are all right with approved solvent. Wipe out the ceramic insulator on the inside of the spark plug barrel with a cloth swab, moistened with solvent.

7. When the plugs have been cleaned thoroughly, dry them out with dry, compressed air.

8. After the spark plugs have been cleaned, inspect them again for cracks, burred threads, and other damages.

(d) ADJUSTMENTS.

1. Adjust the spark plug gap to .012 inch (minimum, .011 inch, maximum, .014 inch). (Adjustment should be made with approved equipment only.)

2. When adjusting the gap, do not permit pressure to be exerted against the center electrode, either directly from the gapping tool or by leaving the gage in the gap while the ground electrodes are being closed. The insulation may be damaged by such pressure.

(e) INSTALLATION.

1. Apply a light coat of compound anti-seize, graphite base, Specification No. AN-C-147, to the first three or four threads of the spark plug.

2. Clean the spark plug bushings in the engine cylinders.

3. On each plug use a fully annealed, solid copper gasket. Do not use old gaskets which have become hard, distorted, or burred from previous service.

4. Tighten the spark plugs to a torque value of 300 to 360 inch-pounds.

5. Use a snug fitting wrench to tighten an elbow connection on a shielded plug. Be careful not to fracture the spark plug barrel ceramic sleeve. Do not apply more than 180 inch-pounds of torque.

(5) IGNITION SWITCH.

(a) DESCRIPTION.—One of three types of ignition switches has been installed in the pilots' compartment of these airplanes. The three types used include A2A-10, B-5, and B-6. The switch unit incorporates a master "ON-OFF" switch, and an ignition switch for each engine. The master switch must be "ON" for the individual engine switches to operate. Each engine magneto switch has four positions which control the four circuit conditions, "OFF," "L," "R," and "BOTH." When the switch is in the "OFF" position, the circuits are grounded out and are inoperative. When the switch is on "R," the right magneto circuit is "OPEN" and spark is furnished to the front spark plugs of all cylinders. When the switch is on "L," the left magneto circuit is "OPEN" and spark is furnished to the rear plugs. When the switch is in the "BOTH" position, both circuits are open and both magnetos are operating.

(b) REMOVAL.

1. Disconnect the ignition plug at the magneto. If this step is not accomplished the magnetos are operative even though the switch is in the "OFF" position or is removed altogether.

2. Remove the overhead panel on some airplanes. If the switch is mounted onto the surface of the panel, it is necessary only to remove the attaching screws and pull the unit outwards.

3. Disconnect the wires from the switch and remove the switch.

(c) MAINTENANCE.

1. If the ignition switch is believed to be operating improperly, remove switch unit as described in paragraph 6.*d.*(5)*(b)*, this section, and apply the following test: (Use a battery or small transformer as a source of current).

a. Connect two test lamps to the switch.

b. Connect a battery to both lamps.

c. Connect one lamp (L) to both "L" terminals of the switch unit; connect a lamp (R) to both "R" terminals of the switch unit.

d. With the master ignition switch in the "ON" position, and the "BOTH" position on the switch not being tested, the lamps should function as shown in the following table:

	LAMPS	
Switch Position	*R*	*L*
"BOTH"	OFF	OFF
"L"	ON	OFF
"R"	OFF	ON
"OFF"	ON	ON

e. With the switch in the "BOTH" position, push the master ignition switch to the "OFF" position. Both lamps should light.

Note

When the light is on, the corresponding magneto is grounded, and thus inoperative.

f. Test both ignition switches by this same procedure.

2. If the ignition switch proves faulty, replace with a new switch.

(d) TEST BEFORE INSTALLATION.—Apply the preceding test.

(e) ASSEMBLY AND INSTALLATION.—Reverse the procedure described in paragraph 6.*d.*(5)*(b)* removal, preceding.

e. ENGINE CONTROLS.

(1) DESCRIPTION.—Each engine has an individual throttle, carburetor mixture, and carburetor hot air control. The controls consist of levers located on the control pedestal in the pilots' compartment, cables connecting from the levers to the main control cables and a bell crank push-pull rod system forward of the fire wall, which transmits the cable movement to the controls on the engine. The main cable assemblies consist of a long cable and a short cable connected by a turnbuckle. In each case, the short cable connects to the bell crank on the fire wall. Thus, the turnbuckle on each cable is located inside the nacelle where it is easily accessible. Each set of control levers has its own locking device which enables the controls to be locked in any position. The throttle levers are located on the "neck" or quadrant part of the control pedestal and the knobs on the levers are marked with a "T." The left lever operates the throttle on the left engine and the right lever operates the throttle on the right engine. The carburetor mixture controls are located next to the throttle controls and are marked with an "M." The carburetor heat controls consist of three levers mounted at the side of the body of the engine control pedestal on the right, or copilot's side. The carburetor heat control lock lever is marked with an "L" and the two carburetor heat control levers are designated with "C" on the knob of the control levers. Other controls affecting the performance of the engines are the propeller pitch controls (paragraph 7.*e.,* this section), the nonram carburetor air filter control (paragraph 13.*b.* (1), this section), and the oil cooler shutter controls (paragraph 9.*e.,* this section).

Note

For proper tension on all engine control cables, refer to cable rigging chart, figure 336.

(2) THROTTLE CONTROLS.

(a) DESCRIPTION.—A push-pull rod is connected to the bottom of each throttle control handle. The rod is attached to a bell crank (2, figure 231) near the base of the control pedestal. Cables attach to the bell crank and lead back through the fuselage to the point where they attach to the main throttle control cables (5, figure 231) in a pin and clevis fitting. The main cables pass around pulleys in the center wing. From the pulleys, the left throttle control cables lead out through the center wing to pulleys in the left nacelle. There is a turnbuckle in the cable assembly at this point and from the turnbuckle the cable passes through a fair-lead in the fire wall and connects to the bell crank (9, figure 231) mounted on the fire wall. The push-pull rods and bell cranks connect the fire wall bell crank to the throttle control on the carburetor. The throttle controls can be locked in any position by applying the lock control. This lock control is a knob located on the under side of the control pedestal directly under the throttle control levers. Turning this control clockwise draws the throttle control brake band tight around the throttle control drum and, through friction, locks the throttle levers in the desired position and prevents "creeping" of the controls. On C-47B airplanes a stop is installed on the throttle quadrant on the engine control pedestal in the pilots' compartment. This stop locates the throttle control levers in full-throttle position for low blower operation. This stop should never be exceeded in low blower operation. Full throttle for high blower operation is attained by a slight outboard pressure being exerted on both throttle levers while advancing them past low blower stops.

(b) REMOVAL.

1. Disconnect the throttle control cables at the turnbuckles in the nacelle.

2. Remove the first center floor panel aft of the control pedestal.

3. Working through this opening, disconnect the short cable which leads to the control pedestal from the main throttle control cable (5, figure 231). The cable fittings at this point are clevis and pin connections.

4. Remove the guard pins from the pulley cluster in the center wing. This pulley cluster may be reached through the selector valve access holes located at the forward edge of the center wing section to the left and right of the airplane centerline.

5. Pull the throttle control cables through the pulley cluster into the nacelle.

CAUTION

Pull the cables through the pulley cluster slowly and carefully so that there is no danger of chipping the Micarta pulleys.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Examine all bearing rod ends for freedom of movement and replace any rod ends found faulty.

2. Inspect all pulleys. Damaged pulleys should be replaced.

3. Check all cables and replace any cable that shows more than six wires broken in any 1-inch length.

(d) INSTALLATION.—The throttle control cables may be installed by reversing the removal procedure and adjusting the cables to their proper tension. (Refer to figure 336, cable rigging chart.)

(e) ADJUSTMENTS.

1. Two men are required to make engine control adjustments. One man in the pilots' compartment checks the position of the control levers. The other man adjusts the push-pull rods at the fire wall. All lever adjustments should be made at the fire wall. Cable tension adjustments should be made at the turnbuckle in the nacelles.

2. The man in the pilots' compartment can tell by checking the throttle control levers which rods should be shortened or lengthened.

Note

The throttle levers should not be all the way against the control pedestal frame when in either the "OPEN" or "CLOSED" position. There should be a ¾-inch space or "spring back" at both extreme positions of the throttle control levers. The two control levers should be lined up until they are exactly even when in the open position.

3. Adjust the rods on the fire wall (6, 8, and 14, figure 231) by disconnecting the bearing rod ends, loosening the lock nuts and turning the bearing rod ends to the desired length.

4. Work throttle control levers and check throttle lever on carburetor to see that it moves through its entire range when throttle levers in pilots' compartment are moved from one extreme to the other.

5. For low blower operation on C-47B airplanes adjust the throttle stop as follows:

a. Place throttle levers on control pedestal in pilots' compartment in full-throttle position.

b. Check carburetor throttle control arms (1, figure 232a) for full-throttle position.

c. Re-rig cables to coordinate throttle control arms with throttle levers in pedestal if necessary.

d. Place throttle adjusting washers, or equivalent (2, figure 231a) on mixture adjustment shafts of the carburetors.

e. Move throttle levers until throttle control arms come in contact with adjusting washer.

f. Adjust stop on control pedestal (1, figure 232b) so that shoulders rest against both throttle levers.

Note

Remove the washer from the mixture adjustment shafts after throttle lever adjustments are made.

(3) MIXTURE CONTROLS.

(a) DESCRIPTION.—The mixture control is a direct cable control from the control lever on the control pedestal to the clevis connection on the main control cable (3, figure 232). The main cable is routed back through the fuselage to the pulley cluster in the center wing section and then to the nacelles where the turnbuckles are located. From the turnbuckles the cable passes through fair-leads in the fire wall and connects to the bell crank (7, figure 232). The push-pull rod and bell crank system forward of the fire wall is similar to the throttle system. Each control lever on the control pedestal has a thumb-operated catch-type lock (1 and 2, figure 232) that enables the control to be locked in either the "AUTO-RICH" or "AUTO-LEAN" position. The spring-loaded catch engages notches in the quadrant at the above positions.

(b) REMOVAL.—The mixture control cable may be removed in the same way as outlined for the removal of the throttle control cable in paragraph 6.*e.*(2)*(b),* this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—(Refer to paragraph 6.*e.*(2)*(b),* this section.)

(d) INSTALLATION — Reverse the removal procedure.

(e) ADJUSTING THE MIXTURE CONTROLS.—Adjust the link rods (4, 6, and 12, figure 232) on the fire wall until the lock catch on the two mixture control levers engage the notch in the "AUTO-LEAN" position at exactly the same time.

(4) CARBURETOR AIR INDUCTION SYSTEM. *(See figure 233.)*

(a) DESCRIPTION.—Cables attach to a two arm bellcrank which is an integral part of the carburetor air induction system control hand levers. These cables attach to the main cable under the first floor panel aft of the pilot's control pedestal. The main cables pass through the fuselage to the center wing and out to the nacelles over the same routing as the throttle and mixture cables.

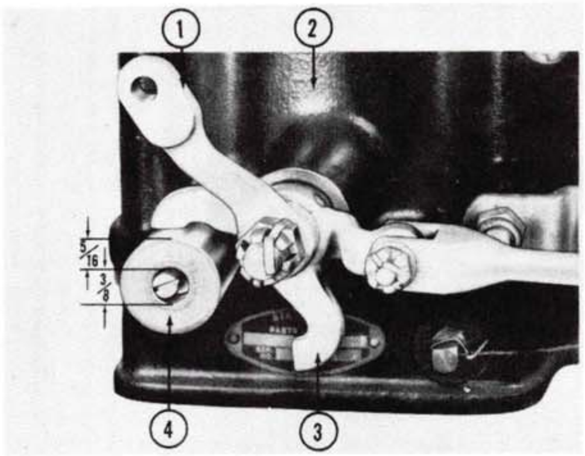


Figure 232A—Carburetor Throttle Control Arm

1. Full-throttle position for low-blower operation.
2. Carburetor.
3. Throttle Control Arm.
4. Adjusting Washer.

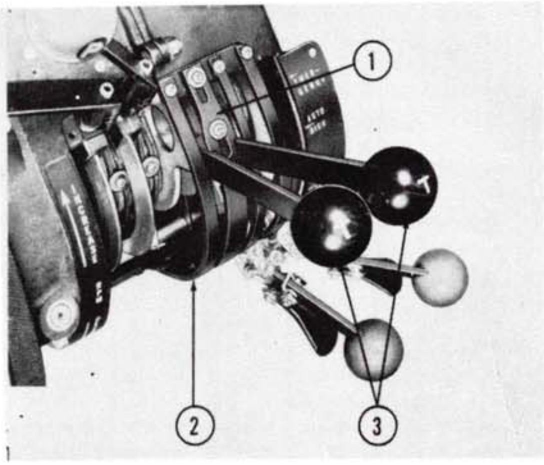


Figure 232B—Throttle Control Quadrant, Engine Control Pedestal

1. Throttle Stop.
2. Control Pedestal.
3. Throttle Levers.

On C-47 and some C-47A airplanes the fire-wall arrangement of push-pull rods and bell cranks is similar to the throttle and mixture control system, except that instead of connecting to the carburetor, the control rod attaches to a lever on the carburetor air temperature adapter. On C-47B airplanes, using the manually controlled Ram Non Ram type air induction, the control rod attaches to the pulley-cam assembly of the induction mechanism.

The control lever lock on the control pedestal consists of a wedge shaped disc attached to the brake lever. When the brake is pulled into a lock position, the thick part of the wedge binds against the carburetor air induction system control lever bell crank discs and, through friction, holds the controls in the desired position. When the brake is released, the thin part of the wedge allows the carburetor air induction system levers to move freely.

(b) REMOVAL.—(Refer to paragraph 6.*e.*(2)*(b)*, this section.)

(c) MAINTENANCE REPAIR OR REPLACEMENT.—(Refer to paragraph 6.*e.*(2)*(e)*, this section.)

(d) INSTALLATION.—Install the carburetor heat control cable by reversing the removal procedure.

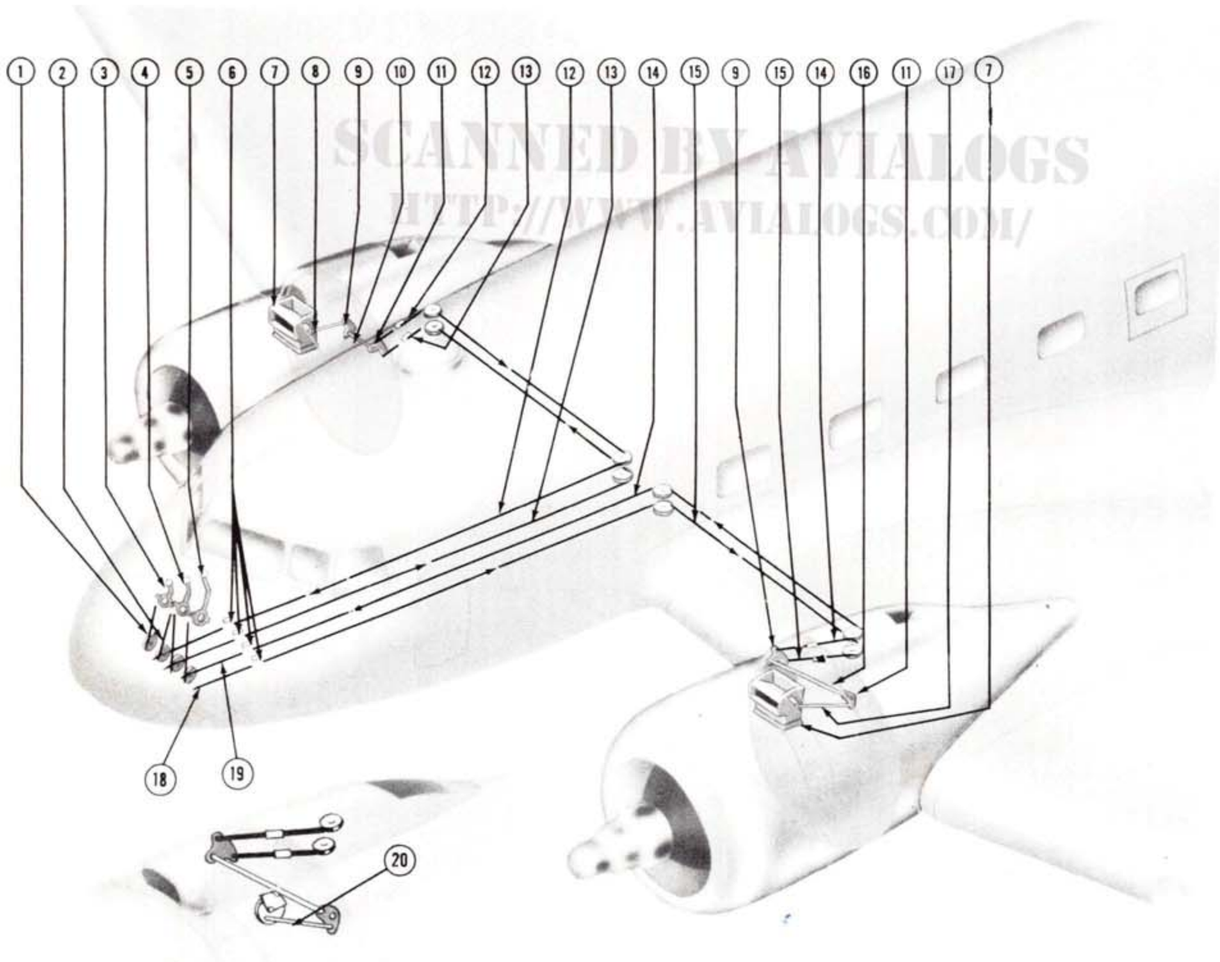
(e) ADJUSTMENTS. — Adjust the push-pull rods on the fire wall until the two carburetor heat control hand levers are exactly even when in the forward position. Allow approximately a ¾-inch clearance or "spring back" on both levers at either extreme of their travel. It is possible to tell when the valve intake door

KEY TO FIGURE 233

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2115277-24	RH Cable—Pedestal to Main Cable	1
2	2115277-22	RH Cable—Pedestal to Main Cable	1
3	2116162-1	RH Control Lever	1
	1116228	Knob	1
4	2116161-1	LH Control Lever	1
	1116227	Knob	1
5	2116167	Lock Assembly	1
	Consists of:		
	2116163-1	Lever	1
	2116166	Cam	1
	1116230	Knob	1
6		Clevis and Pin Fitting	
7		Carburetor Hot Air Door	
8	2032516A-1300	Rod Assembly	1
	Consists of:		
	2032516A-1300	Rod	1
	AF33A6241	Rod End	2
	AN316-4R	Nut	2
	Attached by:		
	AN3-10	Bolt	2
	AN310-3	Nut	2
9	1117731	Bell Crank	2
10	2032516A-1608	Rod Assembly	1
	Consists of:		
	2032516A-1608	Rod	1
	AF33A6241	Rod End	2
	AN316-4R	Nut	2
	Attached by:		
	AN3-10	Bolt	2
	AN310-3	Nut	2
11	1117722-1	RH Bell Crank	1
	1117722	LH Bell Crank	1
	Cables attached by:		
	AN393-9	Pin	2
12	4114029-25	RH Carburetor Heat Control Cable Assembly	1
	Consists of:		
	4114029-1	Cable	1
	4114029-24	Cable	1
	1203473	Turnbuckle	1
13	4114029-23	RH Carburetor Heat Control Cable Assembly	1
	Consists of:		
	4114029-1	Cable	1
	4114029-22	Cable	1
	AN155-16L	Turnbuckle	1
14	4114029-3	LH Carburetor Heat Control Cable Assembly	1
	Consists of:		
	4114029-1	Cable	1
	4114029-2	Cable	1
	1203473	Turnbuckle	1
15	4114029-5	LH Carburetor Heat Control Cable Assembly	1
	Consists of:		
	4114029-1	Cable	1
	4114029-4	Cable	1
	1203473	Turnbuckle	1

KEY TO FIGURE 233 (Continued)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
16	2032516A-2408	Rod Assembly	1
	Consists of: 2032516A-2408	Rod	1
	AC33A6241	Rod End	2
	AN316-4R	Nut	2
	Attached by: AN3-10	Bolt	2
	AN310-3	Nut	2
17	2032516A-1300	Rod Assembly	1
	Consists of: AN3-10	Bolt	2
	AN310-3	Nut	2
	2032516A-1300	Rod	1
18	2115277-20	LH Cable—Pedestal to Main Cable	1
19	2115277-18	LH Cable—Pedestal to Main Cable	1
20	2032516A-1404	Rod Assembly (L.H. and R.H. Engines)	2
	Consists of: AN3-10	Bolt	4
	AN310-3	Nut	4



DETAIL SHOWING MANUALLY CONTROLLED SYSTEM ON MOST C-47B AIRPLANES

Figure 233—Carburetor Hot Air Control System

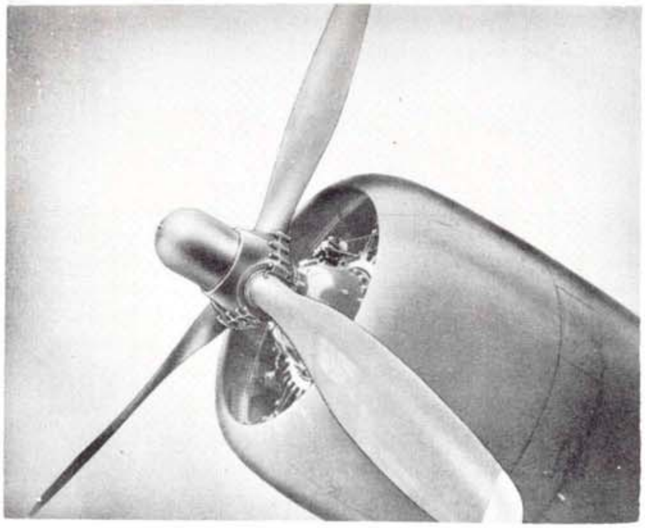


Figure 234—Propeller Installed

in the carburetor air temperature adapter is completely closed by listening while the control lever is placed in the closed position. A positive "click" will be heard inside the carburetor air scoop when the door moves into the full closed position.

7. PROPELLERS AND CONTROLS.

a. GENERAL.—A Hamilton Standard hydromatic propeller (figure 234) is mounted on the propeller shaft of each engine. These propellers are of the quick-feathering type. A Hamilton Standard (engine-driven) constant-speed control (propeller governor) is mounted on the propeller governor pad of the front (nose) section of each engine. The constant speed of each engine is maintained automatically by its constant-speed control (engine-driven propeller governor) which operates to cause a change in propeller blade angle through the constant-speed range (1200 rpm minimum to 2700

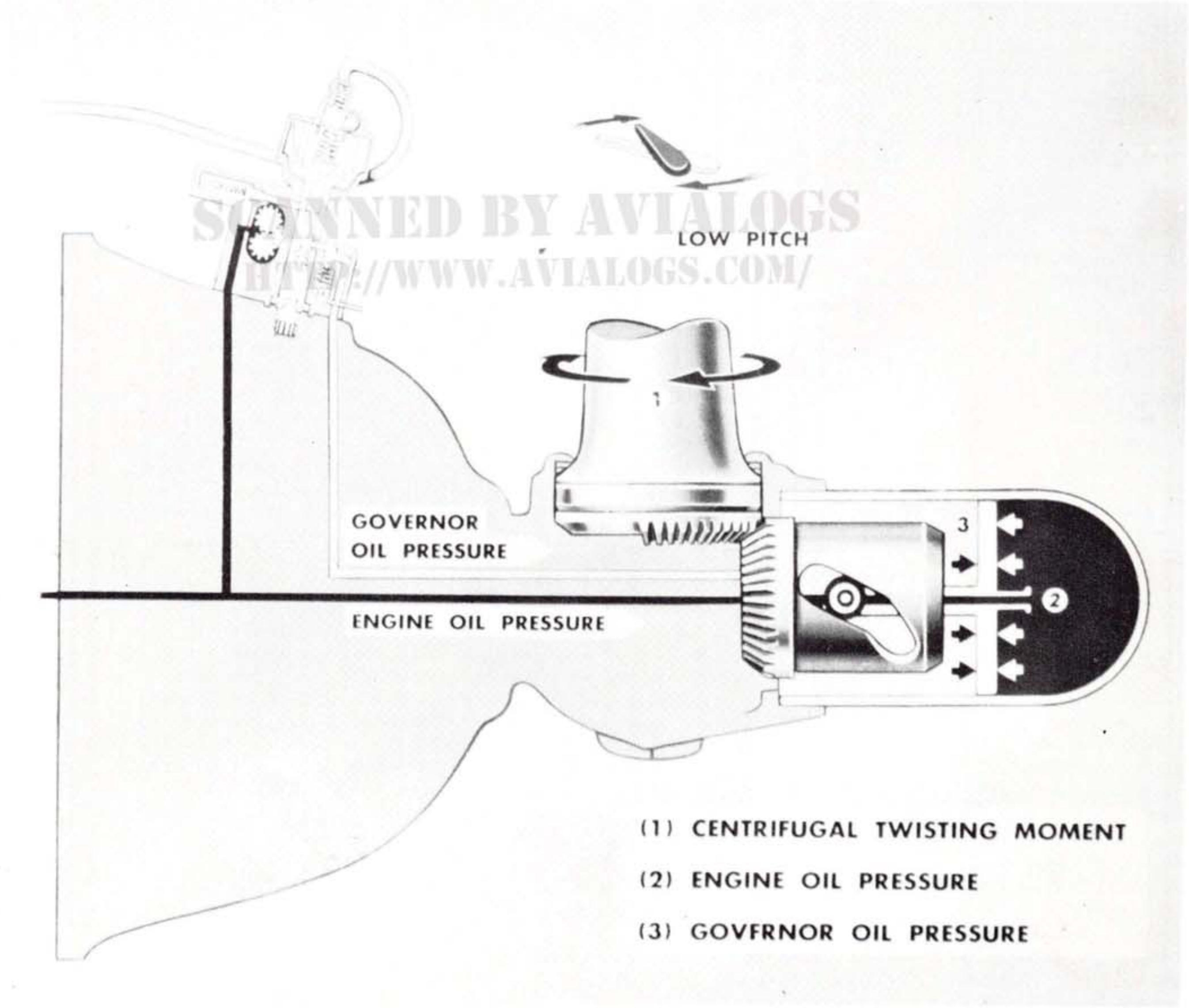

LOW PITCH
1
GOVERNOR
OIL PRESSURE
ENGINE OIL PRESSURE
3
2
(1) CENTRIFUGAL TWISTING MOMENT
(2) ENGINE OIL PRESSURE
(3) GOVFRNOR OIL PRESSURE

Figure 235—Propeller Control Forces

rpm maximum) to meet changing conditions of altitude, attitude, and throttle setting. This change in blade angle is accomplished hydraulically by the constant-speed control through regulation of the flow of engine oil under pressure to and from the propeller. Refer to paragraph 7.*c.*, this section. Each propeller is equipped with a feathering system powered with an individual electric motor-driven hydraulic pump (figure 260) installed on the engine fire wall and electrically operated from the pilot's compartment. The feathering pump supplies oil under high pressure, independent of engine oil pressure, to the propeller for feathering or unfeathering the blades. Refer to paragraph 7.*d.*, this section. To feather the propeller means to place the blades in the full high angle position of 88 degrees, measured at the 42-inch station, so that the blades lie directly in line of flight, acting as powerful brakes to stop rotation of the engine and at the same time reducing drag to a minimum.

b. PROPELLER.

(1) DESCRIPTION.—Each of the two Hamilton Standard, hydromatic, constant-speed, quick-feathering propellers has the following general characteristics:

Basic diameter 11 feet 7 inches
Hub design 23E50-473
Blade design C-47-6353A-18 (narrow)
C-47A-6353A-18 (narrow) or
-6477A-0 (wide)
Low angle 16 degrees at the 42-inch station for blade 6477A-0.
Low angle 18 degrees at the 42-inch station for blade 6353A-18.
High angle 88 degrees at the 42-inch station
Constant-speed range of 1200 rpm minimum—2700 rpm maximum
Propeller reduction gear ratio—16:9.

Three fundamental forces work together to control the blade angle when the propeller is operating in the constant speed or flight range. They are:

(a) Centrifugal twisting moment of the blades toward low pitch which is used to decrease the blade angle.

(b) Engine oil under normal engine-driven pump pressure which supplements the centrifugal twisting moment, thus insuring adequate control force toward low pitch at low propeller speeds.

(c) Engine oil under boosted pressure from the propeller governor which moves the blades toward high pitch. (See figure 235.) Refer to paragraph 7.*c.*, this section, for a description of the constant speed control governor.

(2) REMOVAL AND DISASSEMBLY.—The following procedure for removing the propeller from the propeller shaft is, in general, the reverse of the installation procedure:

(a) REMOVAL.

1. DOME ASSEMBLY REMOVAL.

a. Remove the dome breather hole nut lock wire and the dome breather hole nut; drain the oil from within the dome.

b. Install the dome lifting handle in the dome breather hole. Take out the dome retaining-nut lock-screw cotter pin and remove the retaining-nut lock screw.

c. Back off the dome retaining nut. This nut is attached to the dome and acts as a puller when the nut is unscrewed from the hub. Lift off the dome assembly, using care not to damage the distributor valve assembly.

d. Remove the propeller retaining-nut lock wire. IT IS VERY IMPORTANT that this lock wire be removed before unscrewing the distributor valve from the propeller shaft in order to prevent shearing of the distributor valve housing locking splines.

e. Back off the propeller retaining nut two or three turns; then, using the composite wrench and adapter, remove the distributor valve from the propeller shaft.

2. HUB AND BLADES ASSEMBLY REMOVAL.

a. Install the propeller sling (figure 236).

b. Unscrew the propeller retaining nut.

Note

The propeller hub snap ring, front split cone, and propeller retaining nut are so arranged inside the spider that, as the propeller retaining nut is backed off the propeller shaft, the forward edge of the front split cone will contact the hub snap ring and force the propeller hub blades assembly off the rear cone.

c. Cover the propeller shaft with a thread protector cap.

d. Remove the hub and blades assembly from the propeller shaft.

e. Cover the propeller shaft until installation of the propeller.

KEY TO FIGURE 236

1. Rear Cone
2. Propeller Sling
3. Hub and Blade Assembly
4. Gear Preload Shims
5. Spider and Shaft Oil-Seal Washer (Chevron Packing) and Expander Ring
6. Front Split Cone—Propeller Retaining Nut and Hub Snap Ring
7. Oil-Seal Gasket (Furnished With Engine). Distributor Plate and Oil Tube Assembly (Furnished With Engine)
8. Propeller Retaining Nut Lock Wire
9. Distributor Valve Assembly and Dome Assembly
10. Dome Breather Hole Seal, Washer, Nut and Lock Ring
11. Anti-Icer Fixed Bracket and Feeder Tube Assembly
12. Plugged Propeller Shaft Spline
13. Hub Gear Preload Numbers
14. Hub Balance Arrow
15. Fixed Cam Locating Dowels
16. Distributor Valve Housing Locking Splines
17. Dome Gear Preload Numbers
18. Dome and Barrel Sealing Ring
19. Fixed Cam Stop Ring Flange Fixed Cam
20. Rotating Cam Gear Stop Lug and Rotating Cam Gear
21. Low-Pitch Stop Ring and High-Pitch Stop Ring
22. Dome Balance Arrow
23. Dome Retaining Nut and Lock Screw

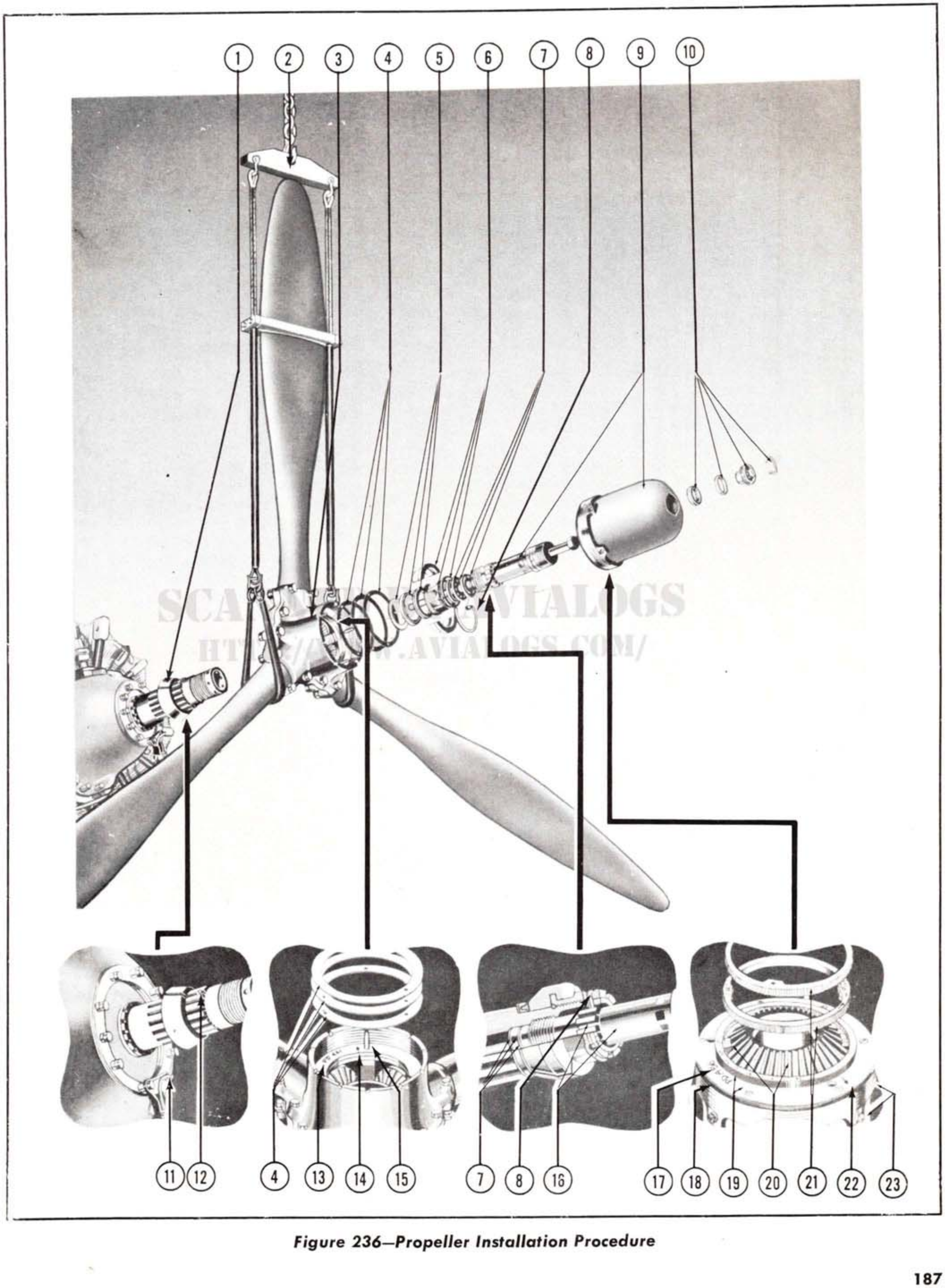

1
2
3
4
5
6
7
8
9
10
11
12
4
13
14
15
7
8
16
17
18
19
20
21
22
23

Figure 236—Propeller Installation Procedure

(*b*) DISASSEMBLY.—Disassembly of propellers other than the accessory disassembly incidental to removal is to be done only at authorized overhaul activities.

Note

> Any operation pertaining to propeller maintenance (repair, replacement, and adjustment) is to be performed only by trained personnel.

(3) ASSEMBLY AND INSTALLATION.

(*a*) ASSEMBLY.—Assembly of propellers other than the necessary assembly incidental to installation is to be done only at authorized overhaul activities.

(*b*) INSTALLATION. (*See figure 236.*)

1. GENERAL. — Hydromatic propellers as prepared for installation on the C-47 or C-47A engine propeller shaft, consist of three sub-assemblies: the hub and blades assembly, the dome assembly, and the distributor valve assembly. Certain smaller attaching parts are also included with the hub and blades assembly at installation. These parts are the rear cone, the spider and shaft oil seal assembly, the front split cone, and the propeller retaining-nut lock wire. The attaching parts included with the dome assembly are the dome breather hole nut and the dome breather hole nut lock wire. The dome assembly is locked in the hub assembly by the dome retaining-nut lock screw and cotter pin. The attaching parts which are used at the installation of the distributor valve assembly include the valve housing and oil transfer plate gasket, the valve housing oil transfer plate, and the oil transfer plate and shaft gasket. Keep the subassemblies of any one propeller together as a complete propeller unit to insure proper balance. The distributor valve assemblies of the same types are interchangeable. Dome assemblies are interchangeable, if previously checked with the hub assembly for balance and gear preload.

2. PREPARATION.

a. Before installing a propeller examine all parts, which are accessible without disassembling the unit, for defects or damage; check for proper fittings. Dress off all corrosion, all raised points, nicks, burs, galls, and scores on joining surfaces of attaching parts; clean all parts thoroughly prior to propeller installation. Remove all small metal particles after any stoning or dressing of propeller parts. Use straight-run gasoline in order to protect the neoprene seals and packings. Do not use aromatic gasoline for cleaning a propeller.

b. Inspect the propeller shaft and threads for nicks, burs, or defects. Dress down defects with a fine stone and polish with crocus cloth. Wash the shaft with gasoline and allow to dry thoroughly. Then apply a light film of clean engine oil to both the inside and outside of the propeller shafts.

c. Install the rear cone and rear cone seat dry. Do not use cup grease or semi-fluid oils for this purpose.

3. INSTALLATION PROCEDURE.
a. INSTALLATION OF ANTI-ICING EQUIPMENT.

(*1*) Remove the two bottom nuts and washers on the thrust-bearing cover plate of the engine's front section. Install the anti-icer fixed bracket and feeder tube assembly (figure 236), onto the two engine studs against the spacers. Replace nuts (but not washers) by hand, leaving bracket loose enough for final clearance adjustment with installation of propeller slinger ring mounted on hub and blades assembly.

(*2*) Connect the anti-icing fluid supply pipe to the feeder tube assembly.

(*3*) After complete installation of the propeller on the engine, check to see that the feeder tube assembly will direct the flow of anti-icing fluid to the anti-icing slinger ring.

b. HUB AND BLADES INSTALLATION. —Prior to installation of the propeller, the propeller shaft will be treated with corrosion preventive compound, Specification No. AN-C-124, to prevent corrosion of the engine propeller shaft due to exposure.

(*1*) On new engines, the propeller shaft with the plugged groove end is usually in the top dead-center position. Do not rotate the propeller shaft prior to the propeller installation because this moves the engine pistons in the cylinders. If the engine is allowed to stand idle before the initial ground run-up, the portion of the cylinders wiped clean of greasy coating by moving the pistons may begin to corrode.

(*2*) Clean the propeller shaft and thrust nut with dry cleaning solvent, Specification No. P-S-661, and inspect the cleaned areas for corrosion.

(*3*) If corrosion is present, remove the thrust nut and repeat cleaning process being careful not to permit any of the solvent to enter the engine.

(*4*) Remove the corrosion by polishing the affected areas with crocus cloth or with a small hand buffing wheel, using jewelers rouge or suitable substitute. Do not use any abrasive coarser than that specified.

(*5*) In case the propeller shaft is pitted, the decision regarding further operation will depend on the depth, character and number of pits.

(*6*) Clean the shaft to remove traces of corrosion and polishing agents.

(*7*) Reinstall thrust nut and tighten to proper torque.

(*8*) Fill the cavity between the thrust nut and the propeller shaft with corrosion preventive compound, type 1, Specification No. AN-C-124.

(*9*) Apply a thin coat of corrosion preventive compound, Specification No. AN-C-124, to the propeller shaft.

(*10*) Install a piece of ⅛ inch rubber sheet, class 2, Specification No. MIL-R-6891, in the slot of the rear cone. Using a razor blade or sharp knife, trim the rubber to the contour of the rear cone cross

HTTPS://WWW.AVIALOGS.COM/

section, being careful not to permit any rubber to protrude beyond the surfaces of the cone.

(11) Coat the shaft area of the rear cone seat liberally with corrosion preventive compound, Specification No. AN-C-124.

(12) Install the rear cone on the propeller shaft, pushing the rear cone against the corrosion preventive compound. Rotate the cone about the shaft and against the thrust nut to displace as much of the compound as possible from the mating surfaces and completely filling the spaces between the rear cone and the thrust nut.

(13) Move the rear cone back until it contacts the propeller shaft thrust bearing nut. Keep the outside surface of the rear cone dry and free from oil. To prevent seizure of the propeller retaining nut or the distributor valve on the propeller shaft, apply a thin film of a recommended thread lubricant to the shaft threads.

(14) With the rear cone in position, wipe off the excess corrosion preventive compound remaining on the cone and exposed portions of the thrust nut. This operation should be performed in such a manner as to leave a thin film of uncontaminated corrosion preventive compound on the mating surface of the cone.

(15) Cover the propeller shaft threads with a thread protection cap that will allow the propeller hub to slide over it. This will prevent damage to the propeller shaft. (See figure 237.) Hoist the propeller hub and blades assembly, with propeller blade that is adjacent to the blank spline in the propeller spider up. This will insure that the propeller blank spline is in line with the wide spline on the engine shaft, and that propeller blade clearance is provided for the work stand. Install the hub and blades assembly on the propeller shaft. While sliding the propeller assembly back on the shaft, tilt the feeder tube assembly to permit the feeder tube to clear the slinger ring attached to the rear of the propeller barrel. Remove thread protection cap after installation is complete.

(16) The spider and shaft oil seal assembly (figures 236 and 238) consists of the spider and shaft oil seal washer, the spider and shaft oil seal, and the spider and shaft oil seal expander ring. These pieces are installed over the propeller shaft in that order to fit forward of the propeller spider splines. The spider and shaft oil seal (chevron-type packing) is installed with "V" edge facing aft against the washer and groover wings facing forward. To aid in properly seating this assembly, use some blunt instrument which will not harm the seals.

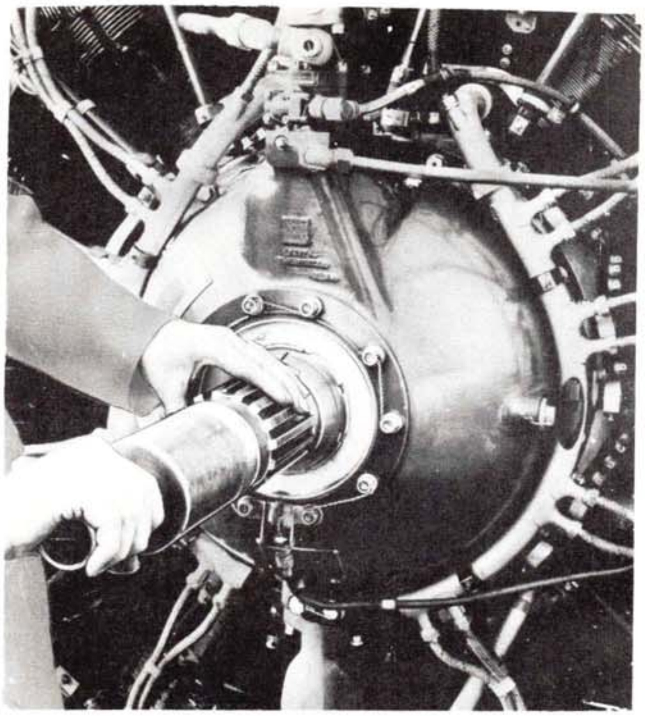


Figure 237—Installing Thread Protector

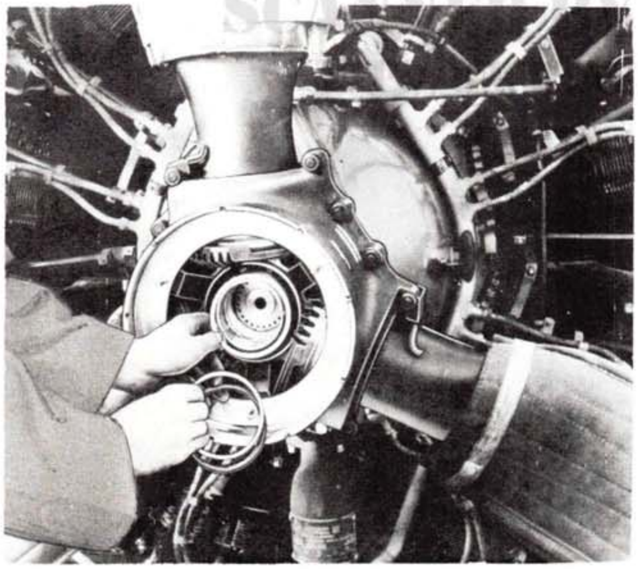


Figure 238—Installation of Spider and Shaft Oil Seal, Oil-Seal Washer, and Oil-Seal Expander Ring

(17) Apply a thin film of a recommended thread lubricant to the threads on the inner diameter of the propeller retaining nut. (See figure 239.) Keep the front split cone outside surface dry and free from oil. Then install the front split cone, consisting of two beveled half rings, on the propeller retaining nut. These parts are machined so that the annular groove inside the front split cone matches with the ledge at the base of the retaining nut. Turn the blades into reverse pitch so that the teeth position of the blade gear segments moves down into the hub. This will provide the necessary clearance to permit installation of the propeller retaining nut and the attached front cone halves. Start the propeller retaining nut and the attached front cone onto the propeller shaft threads by hand. The propeller retaining nut should advance on the threads without binding or catching. If it does not, recheck both the retaining nut and the propeller shaft threads for burs, nicks, etc. Tighten the propeller retaining nut on the shaft using a heavy-duty wrench, if available, in conjunction with a 6-foot bar. The required torque for this operation is 1000 foot-pounds and can be obtained by applying a force of 180 pounds at the end of the 6-foot bar. If a combination wrench is used,

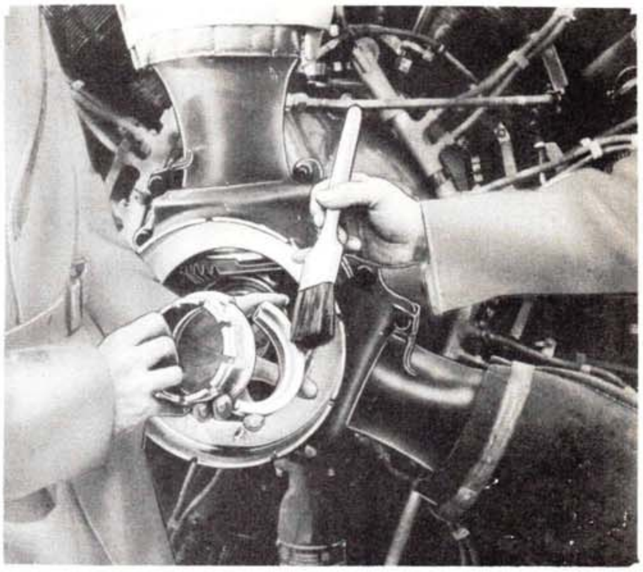


Figure 239—Application of Lubricant to the Retaining Nut and Front Cone

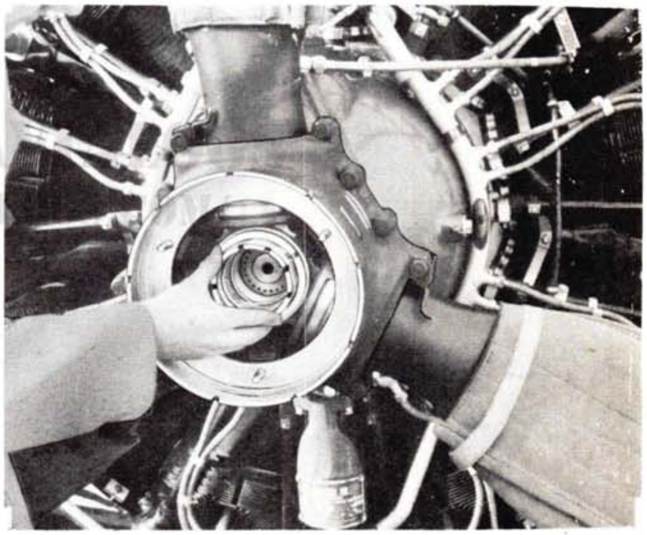


Figure 240—Installation of Propeller Retaining Nut Start by Hand

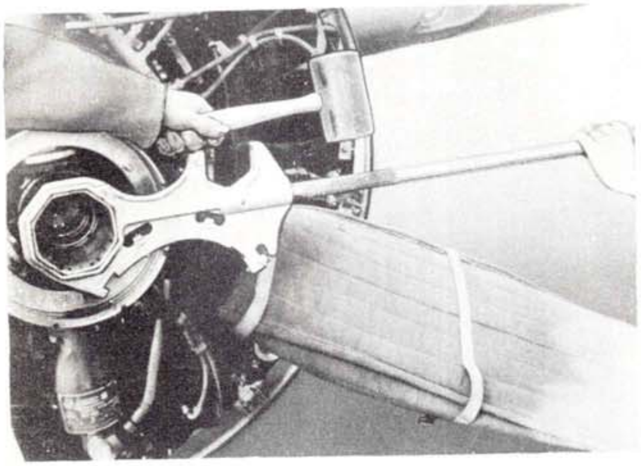


Figure 241—Tightening Retaining Nut With Composite Wrench, Adapter, and Handle

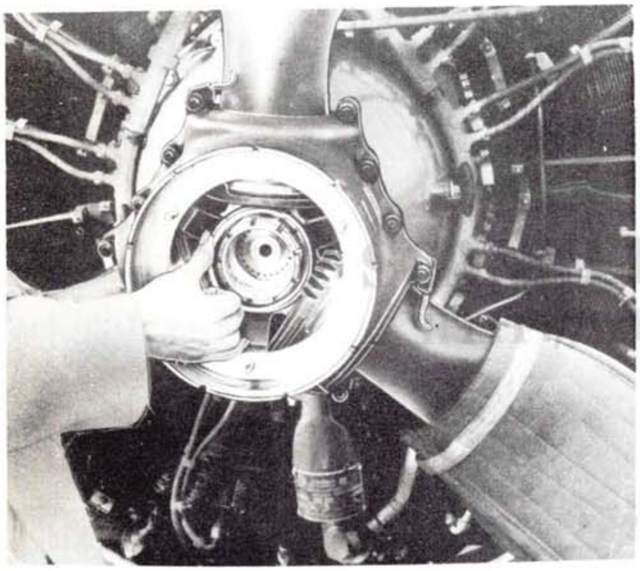


Figure 242—Installation of Hub Snap Ring Into the Spider Hub Snap Ring Groove

apply the force of 180 pounds at the end of a 5-foot bar. (See figure 241.) While this force is being applied, strike the bar close to the wrench with a hammer weighing about 2½ pounds, in order to fully tighten the nut on the shaft. Determine if one of the locking slots in the retaining nut is in alignment with one of the holes in the propeller shaft. If not, repeat the tightening operation until one slot and hole are in alignment. Spacing of the slots in the propeller retaining nut with respect to the holes in the propeller shaft is such that alignment of a slot and hole will occur at each 5 degrees of rotation.

(18) Compress the hub snap ring and install it in the spider hub snap ring groove. (See figure 242.)

(19) Warm up engine and operate for approximately 15 minutes.

(20) Retorque propeller for tightness.

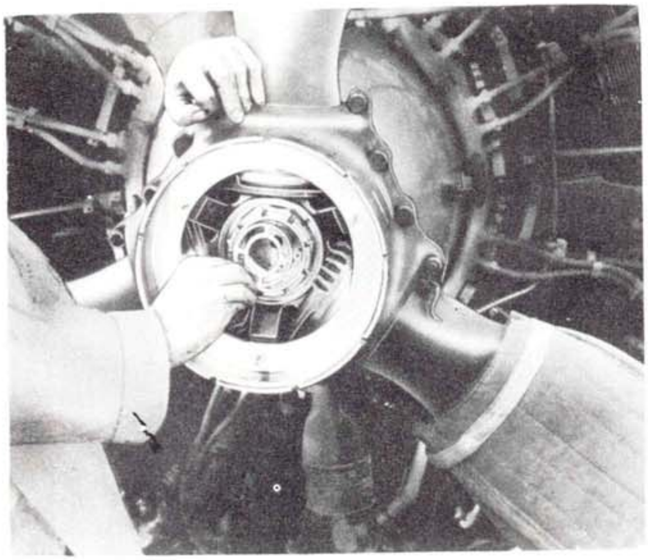


Figure 243—Installation of Oil Transfer Plate and Shaft Oil-Seal Gasket. (Engine Furnished Parts Previously Installed.)

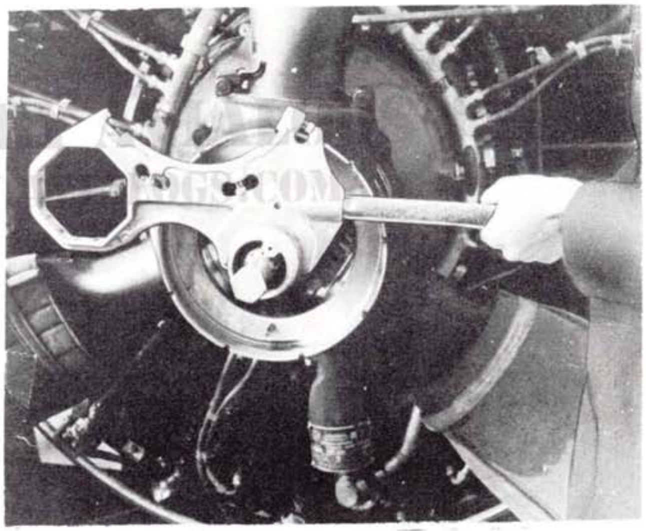


Figure 244—Tightening Distributor Valve by Using Composite Wrench

c. DISTRIBUTOR VALVE INSTALLATION.

(1) Check to be sure that the copper gasket (distributor plate to engine shaft oil seal) and the distributor plate (engine parts) are in place against the adapter flange inside the propeller shaft. (See figure 236.)

(2) Before installing the distributor valve on a new engine, remove the gasket and distributor-plate oil tube assembly from inside the propeller shaft. Wash these two engine parts clean, coat with engine oil, and reinstall them in the shaft.

(3) Install the oil transfer plate and shaft oil seal gasket. (See figures 236 and 243.) This gasket fits over the raised central shoulder and onto the smooth face of the distributor plate (engine part). This 1/32-inch copper gasket is furnished by the

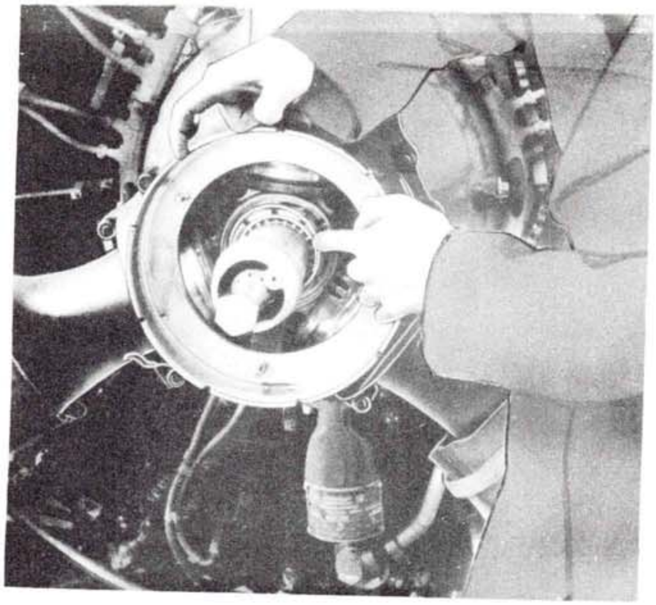


Figure 245—Installation of Retaining-Nut Lockwire. (Tail to Follow Direction of Finger.)

propeller manufacturer. In some new engines another of these gaskets is furnished by the engine manufacturer as a spare.

(4) Check the valve housing oil transfer plate on the base of the distributor valve to be sure that it is the solid-center type, and that the copper gasket is included between the oil transfer plate and the housing. These parts are installed with a snap fit onto dowels in the rear end of the valve housing.

(5) Apply a thin film of a recommended thread lubricant to the threads on the base of the distributor valve. Screw the valve into the propeller shaft by hand.

CAUTION

The valve should advance into the propeller shaft smoothly and easily. If binding is noticed, remove the valve and check the threads of the propeller shaft and the housing for burs, damaged threads, etc.

(6) Tighten the distributor valve into the propeller shaft using the composite wrench, and adapter (41B1862). (See figure 244.) The use of this adapter will permit equal application of torque force on all sides of the valve housing and will prevent the crushing effect encountered when using only the composite wrench. Apply a force of approximately 100 pounds at the end of the one-foot bar and, while this force is being maintained, strike the bar near the wrench one light blow with a hammer weighing not more than 2-½ pounds. Repeat this tightening operation until one of the slots on the distributor valve housing is in alignment with the same hole in the propeller shaft to which a slot in the propeller retaining nut was previously lined up.

CAUTION

Under no conditions should the valve housing

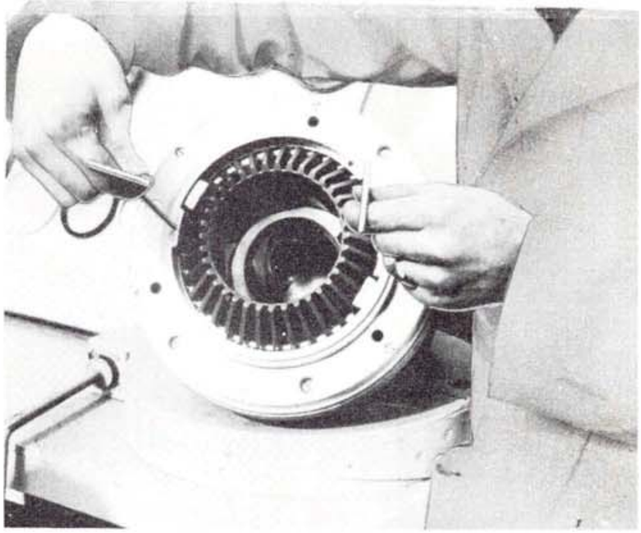


Figure 246—Lifting Out Stop Rings

be backed off, even slightly, in order to obtain slot and hole alignment. If this alignment cannot be obtained without exceeding the specified torque, remove the distributor valve and reinstall it using either a new oil transfer plate and shaft gasket, or reduce the thickness of the first gasket by lapping it slightly. This caution applies as well to the installation procedure described in paragraphs 7.*b*.(3)*(b)3*.c. *(5)* and *(7)*, this section.

(7) Install the propeller retaining-nut lock wire with its head placed through the retaining-nut slot, propeller shaft hole, and into the distributor-valve housing slot (spline groove). Pin head of lock wire should lead in direction of rotation of propeller shaft, while tail end of lock wire should trail. Snap this lock wire as illustrated into position in the lock-wire groove provided for it in the retaining nut. (See figure 245.)

(8) Turn each propeller blade by hand to the high-pitch angle position (88 degrees or full-feathering) against the stop pins. This will place all blade gear segments in proper position for alignment with rotating cam gear in propeller dome.

d. DOME ASSEMBLY INSTALLATION.

(1) When installing the dome assembly, it is *absolutely essential* that the rotating cam gear in the dome be meshed with the blade gear segments in the proper angular relationship, and the following steps should be carried out to insure correct meshing.

(2) Prior to dome installation, check the low-and high-pitch stop rings in the base of the fixed cam to make certain the dome operating range is correctly set for the installation. To reset these rings, lift out the uppermost stop ring which is the high-angle stop ring and is marked "SET TO HIGH PITCH" on one lug, and "ASSEMBLE THIS STOP LAST" on the other lug. (See figure 246.) Then lift out the lower

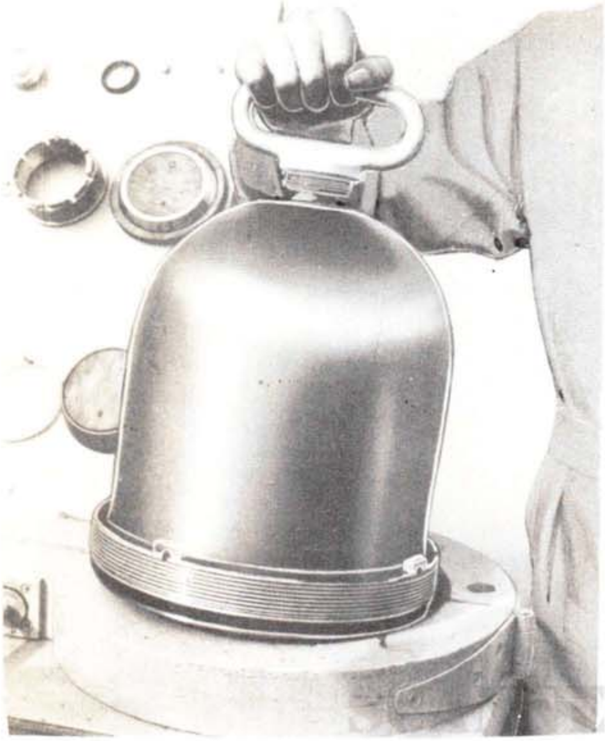


Figure 247—Installing Dome Lifting Handle in Breather Hole

stop ring which is the low-angle stop ring and is marked "SET TO LOW PITCH" on one lug, and "ASSEMBLE THIS STOP FIRST" on the other lug. These rings can best be taken out by inserting 10 to 24 screws in the tapped holes which are incorporated in the stop lug portion of each ring. In order to insure that the stop rings will not fall out of the dome during installation, it is permissible to "SPRING" the stop rings to a slightly out-of-round shape so as to provide sufficient friction to hold them against their own weight. Such "springing" shall not be greater than will permit installation of the rings by hands alone.

(3) Reinstall the low-pitch stop ring (figure 236) to the full low-angle limit by inserting it so that the arrow on the stop ring coincides with the correct low-pitch degree mark (indicating the degrees of blade angle at the 42-inch reference station) stamped on the fixed cam stop ring flange. To insert the low-pitch stop ring, it may be necessary to rotate the cam gear (figure 236) a small amount in a counterclockwise direction to permit inserting the stop ring without interfering with the stop lugs on the gear. It will be noticed that this rotation causes the piston in the dome assembly to move forward.

(4) Reinstall the high-pitch stop ring to the full high-angle limit by inserting it on top of the low-pitch ring so that the arrow on the high-pitch stop ring coincides with the 88-degree mark on the fixed cam stop ring flange.

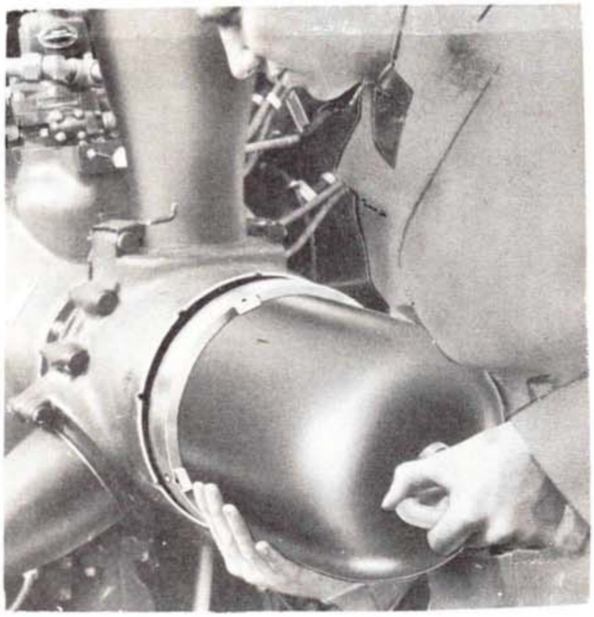


Figure 248—Installation—Starting Propeller Dome Assembly

(5) The stop lug on the rotating cam gear marked "SET WITHIN GRADUATIONS" must lie within the graduated arc of the stop-ring flange on the base of the fixed cam after the stop rings have been installed.

(a) Install the preload shims, if used, over the cam locating dowels.

(b) Move the rotating cam gear in the dome assembly until the cam stop lugs contact the high-pitch stop ring; in this position, the dome piston will be moved into the extreme forward position.

(c) Install the dome lifting handle in the dome breather hole at the extreme forward end of the dome assembly. (See figure 247.)

(d) The dome assembly is initially installed in the hub assembly with the correct number of preload shims in place *but without the dome and barrel seal.* Lift the dome assembly into position and install it over the fixed cam locating dowels in the hub assembly. Make certain that the balance arrow etched on the base of the fixed cam coincides at installation with the arrow stamped on the dome and barrel shelf of the outboard barrel half. Extend the arrow with a pencil mark to a point directly outward on the retaining shoulder of the barrel so as to insure proper installation, if gear preload shims cover the arrow on the hub. Lift the dome assembly into position and align it to match the dome hole arrow to the hub dowel arrow; in this position, the rotating cam gear and the blade gear segments are now in proper alignment to mesh correctly. If there are no arrows marked, the propeller is so perfectly balanced in both hub and dome assemblies that the dome may be installed in any position.

(e) Install the propeller dome assem-

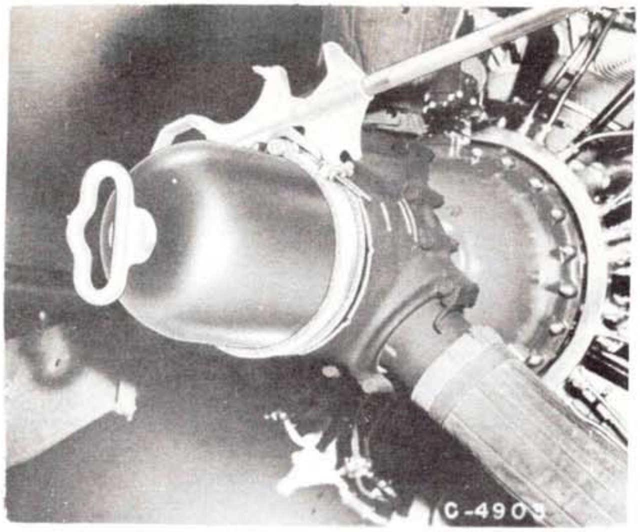


Figure 249—Tightening Dome Retaining Nut With Composite Wrench, 3-Foot Handle

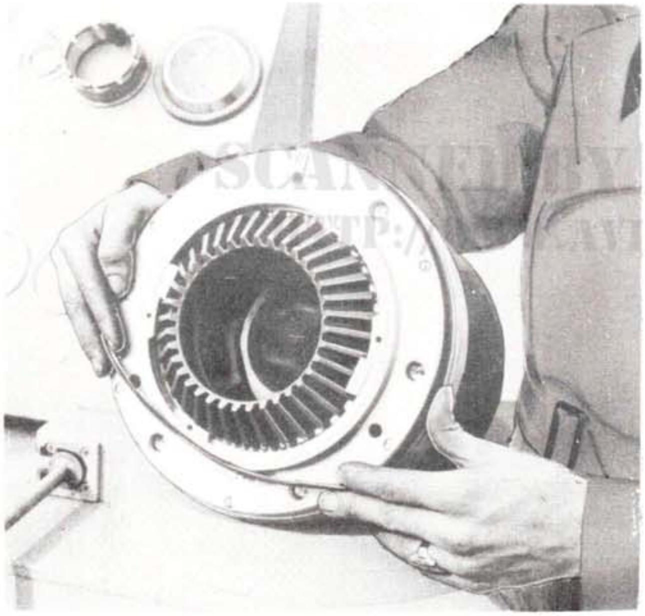


Figure 250—Installation of Dome and Barrel Seal

bly by sliding it straight on over the end of the distributor valve assembly. (See figure 248.) Make sure that the oil seal rings on the valve assembly properly enter into the sleeve inside the piston.

(f) While installing, rotate the dome assembly in a counterclockwise direction until the fixed cam locating dowels in the barrel dome shelf enter the correct dowel holes in the fixed cam. Do not rotate the dome assembly in a clockwise direction to align dowels and holes because, if the gear teeth should engage, this will tend to move the stop lugs on the rotating cam gear AWAY FROM THE FULL HIGH-PITCH ANGLE POSITION, thus allowing the gears to mesh incorrectly.

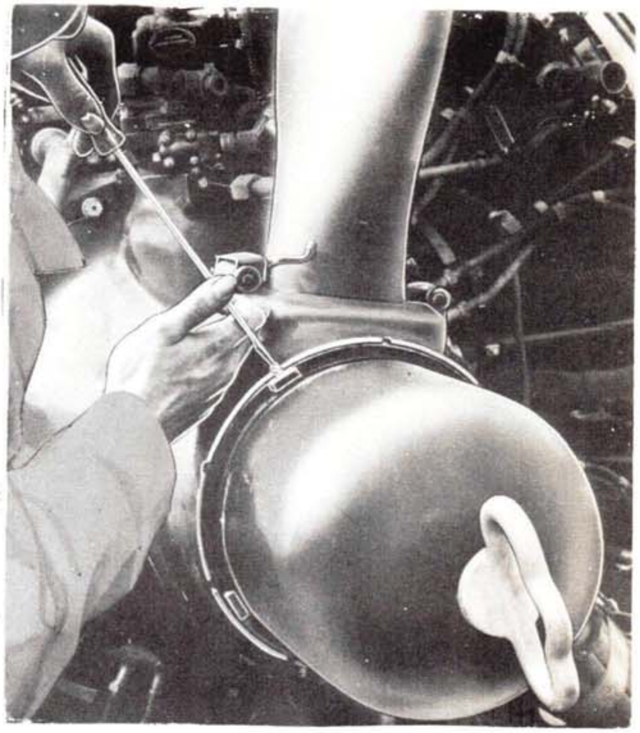


Figure 251—Installation of Dome Retaining Nut Lock Screw

(g) Start the dome retaining nut into the hub assembly by hand-turning the dome retaining nut; then, attach the composite wrench and insert a wrench bar. (See figure 249.) Tighten the dome retaining nut using a maximum torque of 720 foot-pounds (180 pounds at 4-foot radius). While this force is being applied, strike the bar near the wrench with a hammer weighing approximately 2-½ pounds. Continue this tightening operation until the dome assembly seats on the dome-barrel shelf and one of the lock-screw lugs on the dome retaining nut is in line with a half-circle groove in the barrel retaining shoulder. Mark the position of the dome retaining nut with respect to the barrel by drawing a pencil line through the center of the aligning lock-screw lug and half-circle groove.

(h) With the dome assembly properly seated in the barrel, the front face of the dome retaining nut will be approximately flush with the front edge of the barrel retaining shoulder. Tightening of the dome retaining nut, in addition to fastening the dome unit to the hub, serves to apply the preloading force to the gears, and to compress the dome and barrel seal. Failure to tighten the dome unit securely in the hub will result in elongation or failure of the dome shell retaining screws, and oil leakage around the dome retaining nut.

(i) Remove the dome assembly. (See figure 250.) Install the dome and barrel seal on the outer perimeter of the fixed cam base just aft of the dome retaining nut. This seal is installed with the

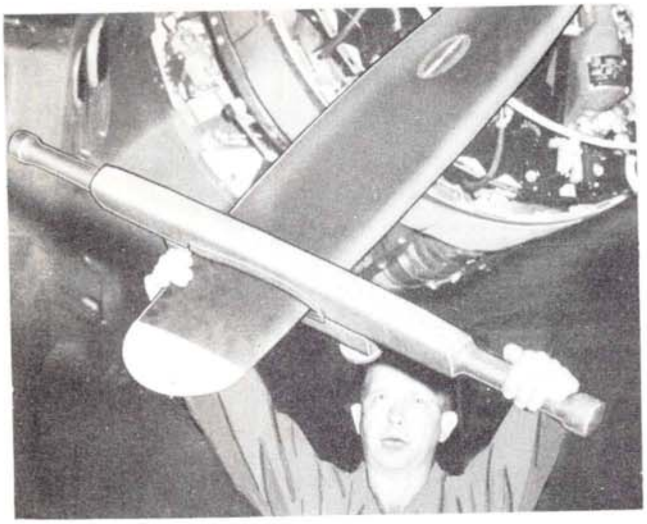


Figure 252—Changing Blade Pitch

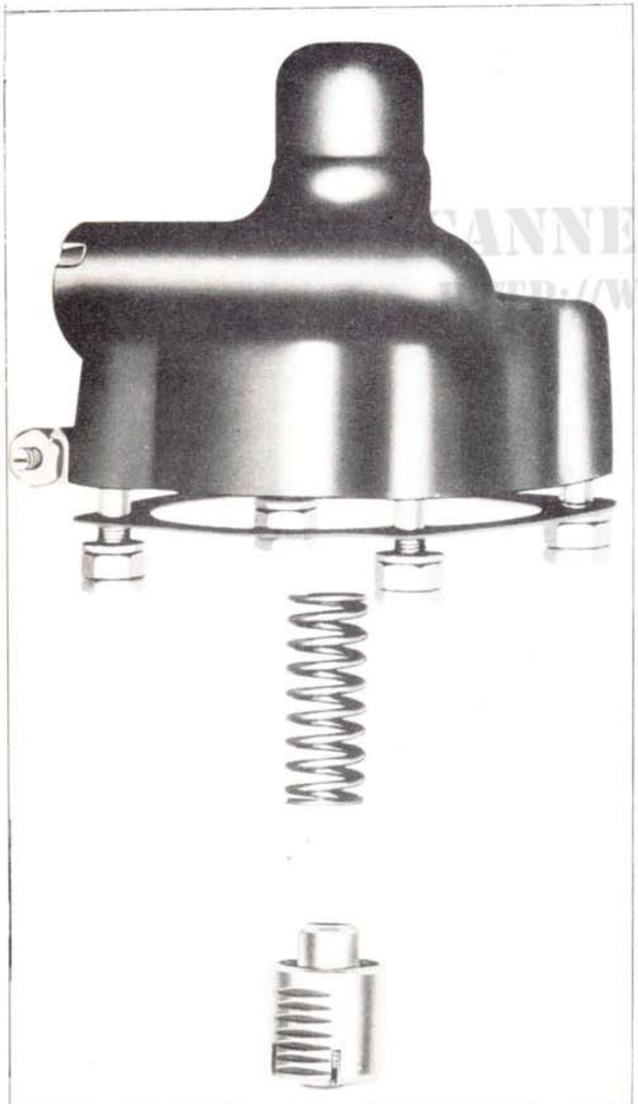


Figure 253—Head, Balance Spring, and Rack Assembly

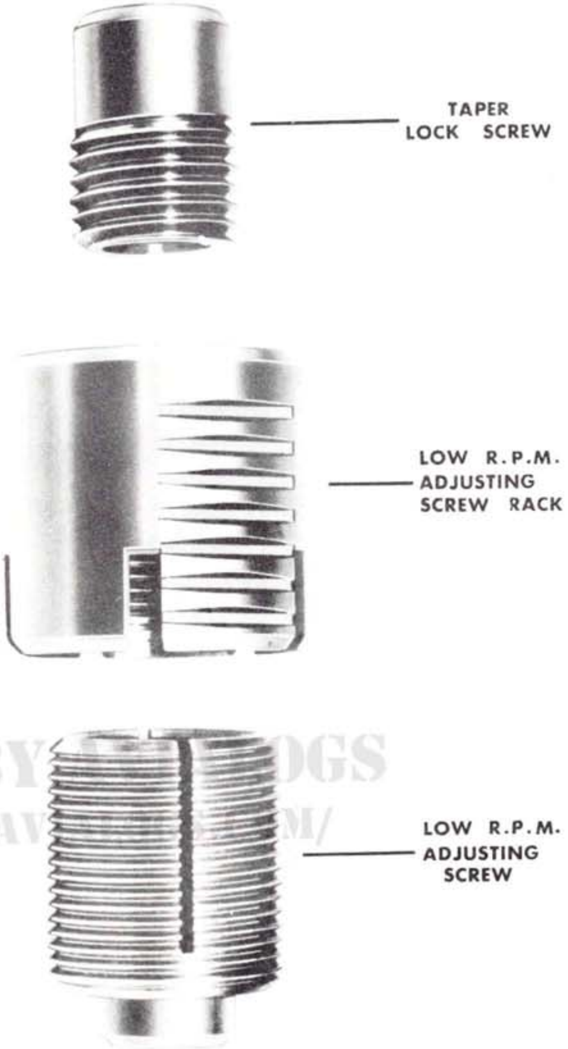


Figure 254—Rack Assembly—Extended

tapered end facing away from the dome retaining nut. Reinstall the dome assembly as before and apply sufficient torque force to the dome retaining nut to bring it to the position previously marked.

(j) Install the dome retaining-nut lock screw in the dome retaining nut and safety this screw with a 1/16 x ½-inch steel cotter pin. (See figure 251.)

(k) Install the dome breather hole seal in the dome breather hole at the outboard end of the dome assembly. This seal is inserted with the tapered portion facing into the dome. Next insert the dome breather hole washer over the seal.

(l) Install the dome breather hole nut in the dome breather hole and tighten it with a torque force of approximately 40 foot-pounds. Continue this tightening operation until one of the holes in the dome breather hole nut is aligned with a slot in the dome shell.

(m) Snap the dome breather hole nut lock wire into the dome shell groove. This lock wire is installed in such a manner that centrifugal force, caused by propeller rotation (counterclockwise), will tend to expand the trailing tail thus preventing slippage or looseness.

(n) Tighten the nuts, on the front of the engine, which hold the anti-icer fixed bracket and feeder tube. (See figure 236.)

(o) Check propeller installation by inspection of blade angles as follows:

1. Using suitable blade turning levers, shift the propeller blades first into the full low-pitch position and then into the full high-pitch position and check the blade angles either by the index line on the shank of the blades and the graduation on the barrel blade bore, or by a protractor at the reference station. (See figure 252.) These angles should be the same as the low- and high-pitch settings of the stop rings. This check will insure that the correct relationship between the blade gear segments and the cam gear has been obtained.

2. If this check for correct blade angles reveals any blade incorrectly positioned, remove the dome assembly. Twist each blade by hand into full high-pitch position against the stop pins. Check the position of the two stop rings in the dome assembly. Turn the rotating cam gear in the dome to full high-pitch stop. Reinstall the dome assembly as described, and recheck the blade angles.

3. With the blade turning levers, twist the blades into full-feathered position (88-degree angles). Check all external screws, nuts, etc, for proper safetying.

(4) TEST AFTER INSTALLATION.

(a) Check the correct blade angles after the installation of the propeller.

(b) FEATHERING AND UNFEATHERING TESTS.

1. During engine warm-up, set the propeller control to full increase rpm, advance throttle until rpm reaches 2000. Move propeller control toward decrease rpm until rpm drops to 1800. Return propeller control to full increase rpm, and note that rpm returns to 2000. Depress feathering button and note that rpm starts to drop. Pull button out to release when rpm reaches approximately 1800, and note that rpm returns to 2000. Reset throttle to desired setting for warm-up.

2. After engine warm-up, a check will be made of the feathering and unfeathering controls through a complete cycle and will be accomplished with the engine stopped and the engine sump drain plug removed so that the oil pumped from the propeller will not collect in the engine crankcase. The oil should drain into a suitable container and be disposed of in accordance with existing instructions covering used oil. Upon completion of the feathering and unfeathering cycle, the engine sump drain plug will be reinstalled and the oil system serviced.

CAUTION

To avoid overloading the engine sump, do not repeat the feathering and unfeathering test until the engine has run for at least 2 minutes at approximately 1000 rpm.

3. The preceding method of testing the feathering operation with the engine running has several important advantages not attainable when feathering is carried out with the engine stationary. They are:

a. It is not necessary to drain the engine sump after each feathering cycle in order to avoid loading the engine with oil since the engine scavenge pump returns the excess oil to the container.

b. The oil is hot and the propeller feathers and unfeathers faster and on a lower pump pressure, thereby reducing the load on the electrical system.

c. The hot oil and rotating engine parts allow a lower engine back pressure during feathering and unfeathering. (This back pressure is caused by the displacement of approximately 3 quarts of propeller oil into the engine lubricating system when the propeller is feathered or unfeathered.)

d. The feathering test is made with oil of relatively low viscosity which approaches more closely the conditions under which the propeller would be feathered in flight.

(5) OVERHAUL.—Disassembly of propellers to a greater extent than shown in figure 236 is to be considered an overhaul procedure and is to be performed by trained personnel only, as an authorized overhaul activity.

c. CONSTANT-SPEED CONTROL (PROPELLER GOVERNOR). *(See figures 255, 256, and 257.)*

(1) DESCRIPTION.—In conjunction with the hydromatic propeller, the constant-speed control is an automatic device used to maintain a constant engine rpm at any engine speed selected by the pilot within the governing range (1200 rpm minimum to 2700 rpm maximum). Driven by the engine, the constant-speed control functions to regulate the flow of oil to the propeller, changing the blade angle to hold the engine speed constant for each new set of flight conditions. Thus, the engine speed is set and controlled independently of engine power; the engine speed being governed by the constant-speed control, while engine power is governed by the throttle. With the hydromatic propeller, the constant-speed control will permit the engine to develop any selected power at any selected engine speed. The engine power and speed will be maintained until the throttle and the propeller governor control lever are readjusted to a new operating rpm.

(a) A Hamilton Standard constant-speed control (propeller governor) is mounted on the propeller governor pad of the front (nose) section of the engine. (See figures 255, 256, and 257.) This unit is a hydro-

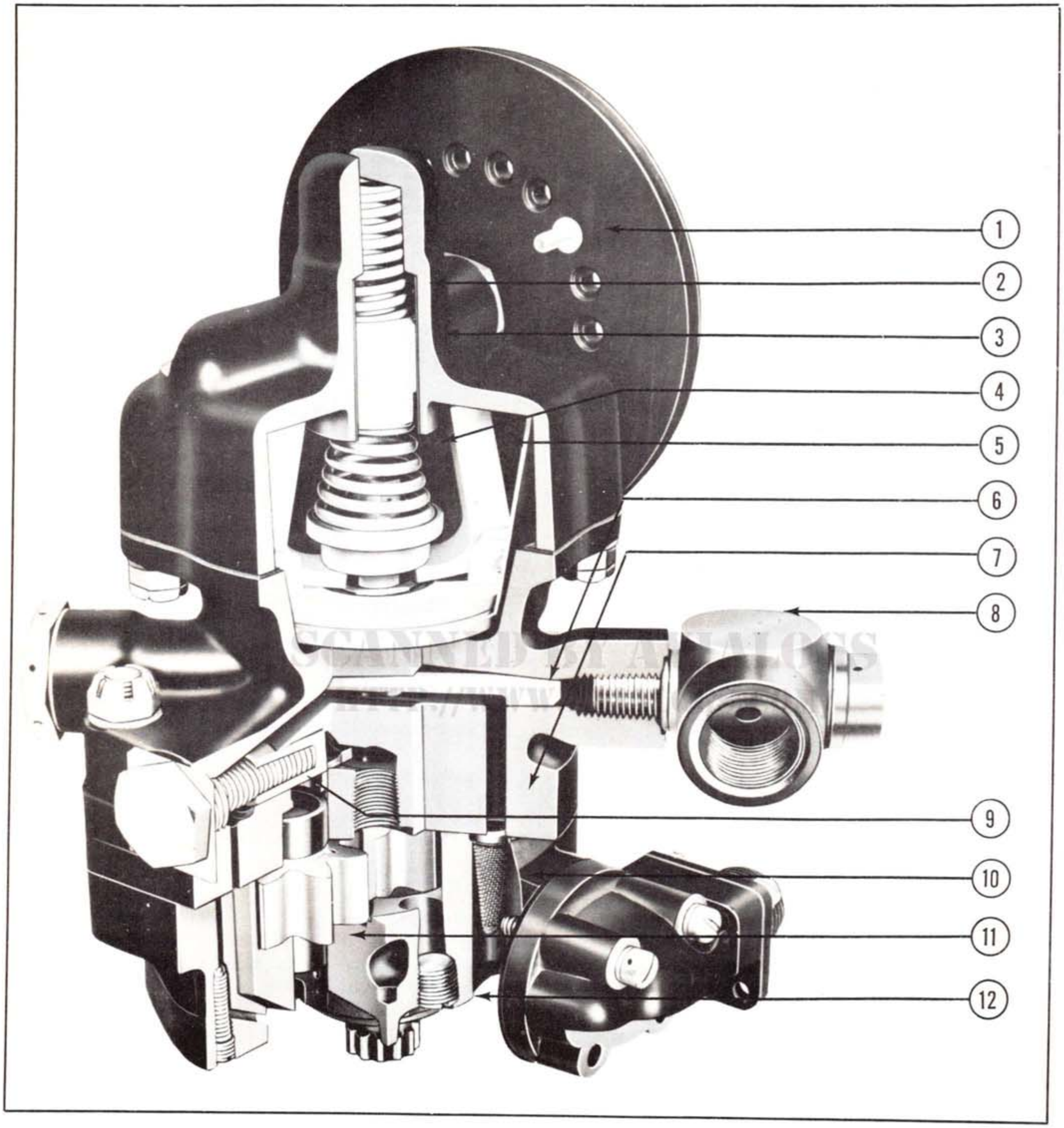


Figure 255—Cutaway View (Front) Constant-Speed Control

1. High RPM Pulley Stop Screw
2. Speeder Rack Balancing Spring
3. Rack Assembly
4. Speeder Spring
5. Fly Weight
6. High-Pressure Valve Plunger
7. Oil Passage to Propeller
8. High-Pressure Valve Elbow
9. Relief Valve
10. Strainer
11. Booster Pump Idler Gear
12. Pressure Cut-Out Switch Assembly

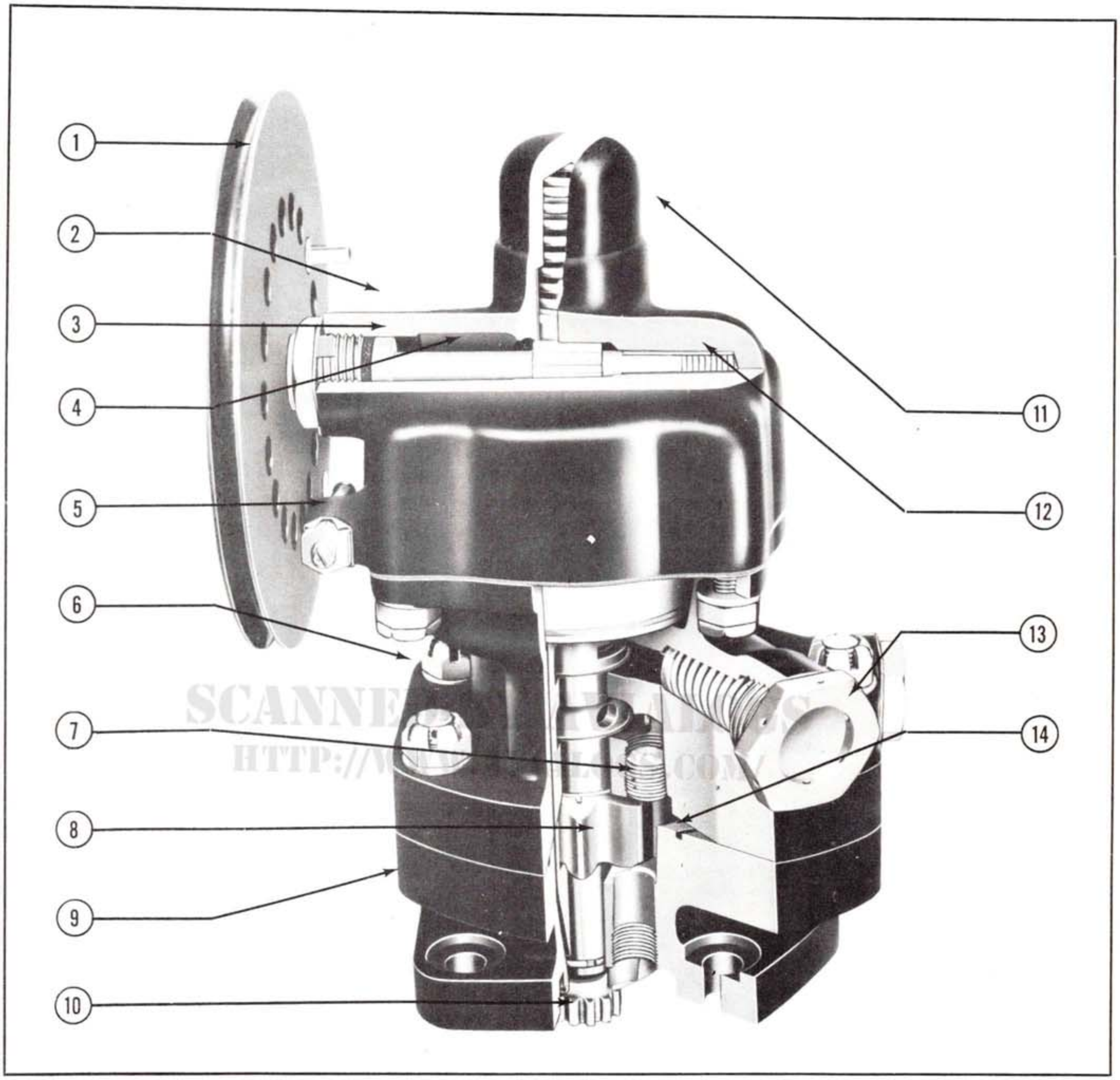


Figure 256—Cutaway View (Rear) Constant-Speed Control

1. Pulley
2. Control Shaft Packing Nut
3. Control Shaft Packing Washer
4. Control Shaft
5. High RPM Adjustment Screw
6. Body
7. Oil Control Plug—Body
8. Drive Gear Shaft
9. Base
10. Drive Gear Shaft Coupling
11. Cover Head
12. Control Shaft Spring
13. High-Pressure Valve Plug
14. Body and Base Oil-Seal Ring

matic propeller governor of the flyball type and is engine-driven. On airplanes having narrow propeller blades (6353A-18), single- or double-capacity governors can be used. On airplanes having wide propeller blades (6477A-O), double-capacity governors must be used. Both the single- and the double-capacity governor, however, operate in essentially the same way. The double-capacity governor is capable of supplying a greater supply of oil at a higher pressure to the propeller. Once set, the governor automatically maintains constant engine rpm by controlling the propeller blade angle within the constant-speed range of 1200 rpm minimum to 2700 rpm maximum for take-off, to meet varying conditions of altitude, attitude, and throttle setting. The minimum rpm at which the governor will control the propeller blade angle is set at 1200 rpm by an internal low rpm adjusting screw. A high rpm pulley stop screw (figure 255) is installed in one of the 18 holes in the pulley. When the pulley is caused to rotate toward high rpm by manipulation of the rpm control lever and the interconnecting linkages, this stop comes in contact with a high adjustment screw which is installed in a boss on the governor head, determining the maximum rpm. (See figure 256.) Adjustment of the two governors, to control rpm of the engines, is made from the engine rpm controls (propeller governor controls) installed on the forward upper structure of the pilot's control pedestal (figure 258). The controls are marked: in the extreme rear position, "DECREASE" (signifying minimum rpm or constant-speed high-pitch limit range); and in the extreme forward position, "INCREASE" (high rpm or low-pitch range).

(b) The governor boosts engine oil pressure to the pressure required for moving the blades toward high pitch. Also the governor meters to, or drains from, the aft end of the propeller piston the quantity of oil required to set and maintain the proper blade angle as necessary to allow the engine to run at constant rpm.

(c) The functions performed by the constant-speed control are governed by the various component parts within the housing. The speeder spring, located in the head of the governor, acts as an adjustable balance for the engine-driven flyballs, balancing or counteracting the centrifugal force exerted by these flyballs at varying engine speeds. Flyball centrifugal force actuates a pilot valve, lifting the pilot valve against the speeder spring. As the speeder spring and flyball forces balance, or one overrides the other, so the pilot valve meters the oil flow through suitable ports in the drive gear shaft to or from the aft end of the propeller piston.

(d) Engine oil pressure is received and boosted by a small engine-driven gear-type booster pump within the constant-speed aft end of the propeller piston to move the propeller toward the high-pitch limit of the constant-speed range. The booster pump is not used to move the blades toward low pitch; this movement is accomplished by normal engine oil pressure on the outboard end of the piston and centrifugal twisting moment of the blades. The governor drive gear shaft is splined at one end to fit the engine drive coupling in the engine pad. This hollow shaft drives both the booster pump and the flyball assembly, while the pilot valve fits inside the shaft.

(e) The governor includes a relief valve to limit the pressure developed. In single-capacity governors, this consists of a simple plunger-type valve. In double-capacity governors, it consists of a plunger-type valve controlled both by the position of the pilot valve, and by a pressure dump valve in the base which limits the maximum pressure. A high-pressure (transfer) valve in the feathering oil pressure passage acts as a shuttle valve to disconnect the governor booster pump oil flow to the propeller feathering and unfeathering operations.

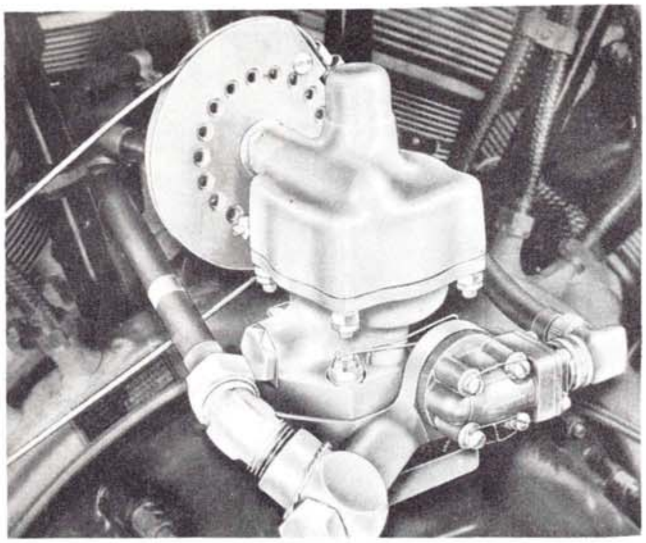


Figure 257—Constant-Speed Control (Propeller Governor) Mounted on Engine

(f) A pressure cut-out switch is connected to the governor oil pressure outlet passage to the propeller. Upon completion of the feathering operation, the oil pressure developed by the feathering pump actuates a plunger within the switch. The automatic plunger movement breaks the feathering electrical circuit to stop the pump. For further information on the electrical function of this switch, refer to paragraph 14.*b.*(6)*(e)*, this section.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.—Remove stop attaching cable to constant-speed control governor pulley. (See figure 257.) Disconnect the feathering pump high-pressure connection, and the electrical control wire from the pressure cut-out switch. Unscrew the mounting stud nuts which secure the governor unit to the engine pad, and remove the governor.

CAUTION

If the governor is being removed temporarily and will be reinstalled, retain the pulley on the governor shaft. If the governor is to be replaced, remove the pulley, noting the relationship between the index mark on the end of the governor shaft and the pulley hub, to permit installation of the pulley on the replacement governor with the same relationship.

(b) DISASSEMBLY.—The constant-speed control governor is to be disassembled only at a repair depot.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) MAINTENANCE REPAIR.—The constant-speed control governor is to be repaired only at a repair depot.

(b) REPLACEMENT.—Replace all faulty governors.

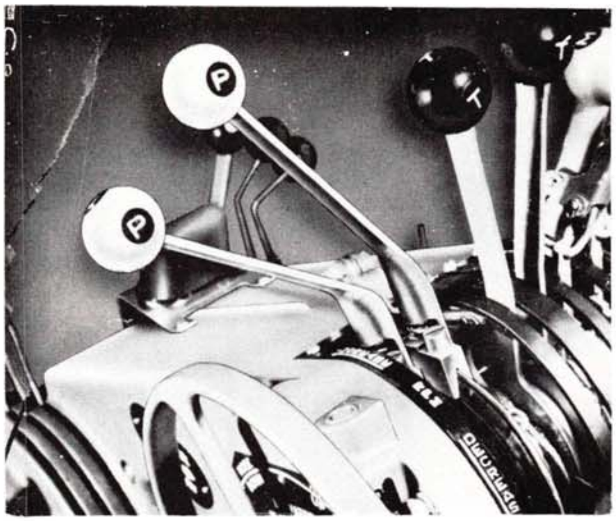


Figure 258—Constant-Speed Control (Propeller Governor) Levers

(4) ADJUSTMENT.

(a) Any adjustment of the governor, with the exception of adjustment of the maximum rpm, is to be made at depots only.

(b) Adjustment of the maximum rpm setting should be accomplished on a governor test stand, if available. In an emergency, if it is necessary to adjust the governor on the airplane, care must be taken to insure that the governor is controlling the propeller during the adjustment process, as otherwise an erroneous setting will result. If the maximum rpm is too high, the governor setting is incorrect, or the governor or some other component of the propeller system may be defective. An attempt to correct the condition by adjusting the governor setting should be made. If the maximum rpm is too low, check whether the governor is controlling the speed by varying the manifold pressure slightly. If the rpm remains constant, the governor is not controlling the propeller. The propeller is acting as a fixed pitch propeller, with the blades against the low pitch stops. Adjustment of the governor on the *ground under these conditions will not increase the rpm on the ground, and may cause dangerous overspeeding in flight.* If this condition is encountered, check the engine for any condition causing loss of power, and then check the maximum rpm in flight. If flight tests indicate the maximum rpm setting is too low, increase the setting slightly as indicated in the following, and check the adjustment by a second test flight. Repeat this procedure until the proper setting is obtained.

(c) Small changes in maximum rpm are made by the stop screw on the governor head, and large changes by changing the hole in which the pulley stop pin is installed. Adjusting the stops so that the governor pulley can rotate further counterclockwise increases the maximum rpm setting.

(5) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY.—Assembly of the constant-speed control governor is to be done at a repair depot.

(b) INSTALLATION.—Check that the governor drive shaft turns freely by hand. Check that the oil control plugs in the governor base and body are in the B-B holes, corresponding to clockwise rotation of the governor drive. The body oil control plug can be seen through the hole in the base. Place the governor on the mounting pad, making sure the correct gasket is in place. Install washers and stainless steel self-locking attaching nuts. Tighten nuts evenly to approximately 100 to 140 inch-pounds torque. Excessive tightness will displace the gasket material and warp the governor base. Connect the electrical connection to the pressure cut out switch, and attach the feathering oil line to the swivel fitting. Install the pulley on the shaft, with the same relationship between the index mark on the end of the shaft and the pulley hub as with the governor removed.

(6) TEST AFTER INSTALLATION.

(a) Before testing the constant-speed control, the propeller should be inspected to check the correct blade angles. This test is necessary to insure the correct relationship between rotating cam gear and blade gear segments. This test will usually be performed after the installation of the propeller. Refer to paragraph 7.*b*.(3)*(b)*3.d.*(5)*(o), this section. DO NOT USE the feathering pump to move the blades to low-pitch position in order to check the blade angles. If oil pressure is used for this purpose before checking the blade angles, serious damage may result to the mechanism due to improper installation.

(b) Set the constant-speed governor control lever (figure 258) in the pilot's compartment to the "INCREASE" (maximum rpm, low-pitch) position, and then start the engine and warm it up in accordance with the engine operating instructions. When the engine is started, the forward end of the propeller dome cylinder will fill with engine oil at normal engine-pump pressure. This pressure, in conjunction with the blade centrifugal twisting moment, will hold the blades against the low-pitch stops. With the propeller blades in full low pitch, and the actual engine rpm lower than that for which the propeller governor is set, the engine rpm will vary directly with engine horsepower output.

Note

> Horsepower varies with rpm and manifold pressure. Rpm is controlled by the propeller governor through change of blade pitch; manifold pressure is controlled by the throttle. In the condition stated above, with the blades in full low pitch, the propeller acts as a fixed pitch propeller and engine horsepower is governed by the throttle which in this case controls rpm as well as manifold pressure.

(c) After completing the engine warm-up period, advance the throttle to some intermediate

engine speed, for example, 1500 rpm. Move the engine rpm control to the extreme "DECREASE" position. At this control setting, the engine will turn faster than the speed for which the governor is set, and the governor will supply oil pressure to the aft end of the propeller piston. In 35 to 45 seconds, when the aft end of the dome cylinder has been filled with oil, the propeller blades will move toward a higher pitch and the engine rpm will drop down to the minimum propeller governor setting.

(d) After the forward and aft ends of the dome cylinder have been filled with oil according to the procedures outlined preceding, move the engine rpm control several times between the "DECREASE" and the intermediate settings to eliminate trapped air from the propeller system.

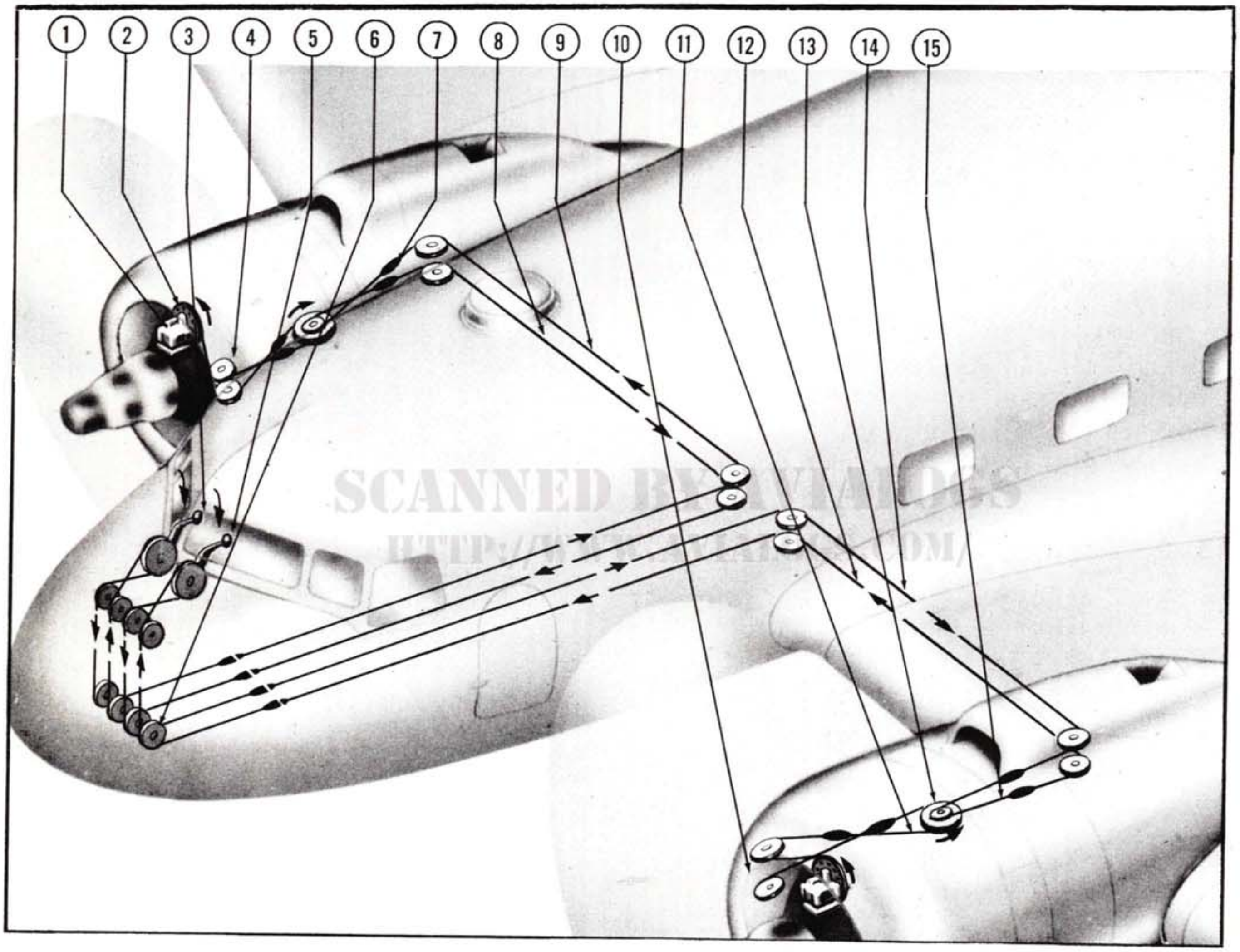


Figure 259—Linkage to Constant-Speed Control (Propeller Governor)

(For cable manufacturing information, refer to section IX)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	4K11-G0J (Single-Capacity Governor—Used with narrow (6353A-18) propeller blades) 4G8-G15D or 4G8-G15G or 4G8-G23D-1 or 4G8-G23G-1 (Double-Capacity Governors—Used with wide (6477A-0) propeller blades)	Hamilton Standard. Constant-Speed Control (Propeller Governor)	2

KEY TO FIGURE 259—Continued

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
2	2116733	Pulley Assembly, Propeller Pitch Control Cable (Left-hand)	1
	Consists of:		
	4143049	Pulley	1
	2116733-2	Cable	1
	1143132	Pin	1
	AN310-3	Nut	1
	AN155-16S	Turnbuckle	2
	S-2049220-16DS-3L	End	2
	AN510-10-10	Screw	2
	AF365-1032	Nut	2
	2116733-1	Pulley Assembly, Propeller Pitch Control Cable (Right-hand)	1
	Consists of:		
	2119653	Pulley	1
	2116733-3	Cable	1
	1118652	Pin	1
	AN310-3	Nut	1
	AN155-16S	Turnbuckle	2
	S-2049220-16DS-3L	End	2
	AN510-10-10	Screw	2
	AC365-1032	Nut	2
3	4115349	Lever and Drum Assembly—Propeller Pitch Control Inboard	1
	Consists of:		
	4116173	Lever Assembly	1
	4115349-2	Cable Assembly	1
	2116132	Drum	1
4	5114462	Bracket Assembly—Propeller Pitch Control Idler Pulley (Location shown—bracket not drawn for purpose of clarity)	1
5	4115348	Lever and Drum Assembly—Propeller Pitch Control Outboard	1
	Consists of:		
	4116174	Lever Assembly	1
	4115348-2	Cable Assembly	1
	2116132	Drum	1
6	AN210-2A	Pulley	20*
7	AN155-16S	Turnbuckle Barrels	12
8	4114029-35	Cable	1
9	4114029-37	Cable	1
10	5114463	Bracket Assembly, Propeller Pitch Control Idler Pulley (Location shown—bracket not drawn for purpose of clarity)	1
11	2115780-8	Cable Assembly	2
	Consists of:		
	2115780-4	Cable	2
	S1084939	Stop	2**
12	4114029-27	Cable	1
13	2118733	Pulley	2**
14	4114029-29	Cable	1
15	2115780-6	Cable Assembly	2**
	Consists of:		
	2115780-2	Cable	2
	S1084939	Stop	2

* Four brackets, two on each fire wall, contain pulleys which act as guides for the 2115780-3 cables. Part numbers are as follows:

LH Nacelle
1117725 Bracket 1 Required
1117724 Bracket 1 Required
RH Nacelle
1117725 Bracket 2 Required

All brackets contain AN210-1A pulleys.

** Component parts of 2115780 Propeller Pitch Nacelle Pulley Control Assembly.

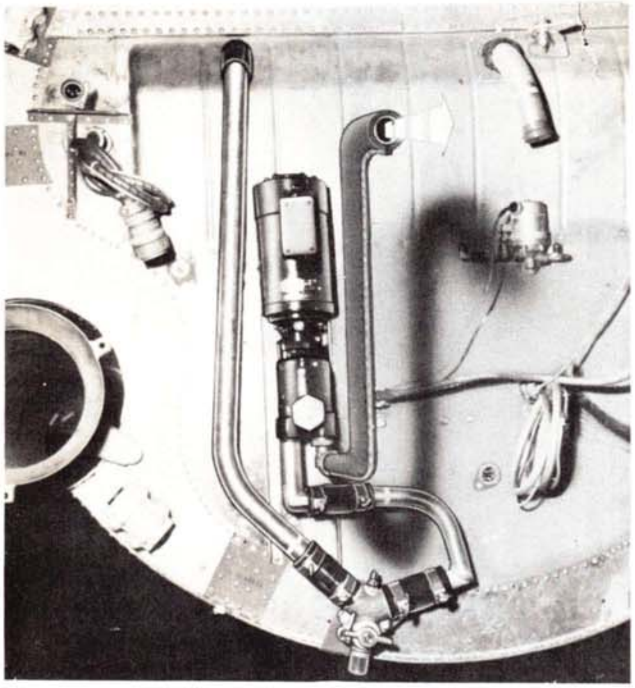


Figure 260—Auxiliary Hydraulic Feathering Pump and Electric Motor Assembly

d. AUXILIARY HYDRAULIC FEATHERING PUMP AND ELECTRIC MOTOR ASSEMBLY. *(See figure 260.)*

(1) DESCRIPTION.—When it is necessary to stop engine rotation in flight, in case of engine failure or testing conditions, the powerful braking effect of the propeller in the feathered conditions is employed. Feathering the blades to the full high pitch position of 88 degrees at the 42-inch station so that the blades lie in the direction of flight prevents windmilling and reduces drag to a minimum. Since the engine-driven oil pump and the engine-driven governor are inoperative when the engine stops, an auxiliary source of power is provided for feathering and unfeathering the propeller.

(a) This power unit is an individual electric motor-driven hydraulic pump assembly (figure 260), one for each propeller, mounted on the forward side of each engine section fire wall. The pump itself consists essentially of a pair of closely meshed steel gears contained within a housing mounted on the end of a 12- or 24-volt motor. Refer to paragraph 14.*b.*(6)*(b)*, this section. To avoid failure to feather and damage to feathering pumps caused by an air lock on the suction side of the pump, the feathering pump housing is vented to the main engine oil line.

Note

Twelve-volt electric motor hydraulic pump assemblies are used on C-47 airplanes for propeller feathering and unfeathering operations; on C-47A airplanes a 24-volt electric motor hydraulic pump assembly is used.

The housing is made up of a heat-treated aluminum-alloy body with an insert of high-grade bronze cast in place, and an aluminum cover having two removable bronze bushings. The intake port and discharge port are located in the cover. A pair of small-drilled holes provide communication between the intake port and gear shafts in order to relieve pressure at the ends of the shafts. An integral relief valve is contained in the cover and is arranged to bypass oil from the discharge port back to the intake port when the discharge pressure exceeds the pressure adjustment. The valve is controlled by a spring whose tension is varied by means of an adjusting nut on the top of the pump. A metallic seal is provided to keep the oil within the pump proper and to prevent air being drawn into the pump. The entire pump assembly is secured to an adapter on the end of the electric motor. The adapter also houses a coupling, drive block, and universal block through which torque is transmitted from the motor shaft to the drive gear. The electric drive motor is controlled by the propeller feathering control switch button in the pilot's compartment.

The electric motor is described in paragraph 14.*b.*(6)*(b)*, this section. The auxiliary feathering pump takes oil supplied from the oil container and pumps this oil under high pressure to the propeller governor housing where this pressure actuates the high-pressure (transfer) valve to disconnect the propeller governor from the system. The transfer valve is actuated to allow high-pressure oil from the feathering pump to flow through the governor base and through the passage in the front (nose) section to the propeller shaft and then through the distributor valve to the propeller dome cylinder. This route from the governor to the propeller dome is the same as that used to conduct oil from the governor booster pump during constant-speed operation.

(b) Feathering is started by depressing the propeller feathering control switch push-button which holds in automatically. During the feathering operation, high-pressure oil is pumped to the aft end of the propeller piston, moving the piston forward to feather the blades while forcing the engine oil forward of the piston to drain into the engine crankshaft, just as in constant-speed operation. When the piston has reached its full forward travel, feathering the blades to 88 degrees, the accumulated oil pressure within the feathering pump lines and the aft end of the dome cylinder actuates the differential pressure cut-off switch on the governor. This action opens the propeller feathering circuit and stops the pump.

(c) Considerably greater oil pressure is required for the unfeathering operation than for the feathering, in order to open the distributor valve in the propeller shaft to redirect the oil flow within the dome cylinder. Movement of the distributor valve is produced during unfeathering operation only by a pressure higher than will actuate the pressure cut-out switch and break the feathering electrical circuit, automatically releasing the feathering control switch in the pilot's compartment which stops the feathering pump motor. For this reason, the feathering control switch must be *held*

down manually to produce sufficient pressure for unfeathering.

(d) During the unfeathering operation in flight with engine dead, high-pressure oil from the feathering pump at first flows to the aft end of the propeller piston. When the pressure builds up to a sufficient value, it actuates the distributor valve which redirects the pump pressure into the forward end of the dome cylinder while oil in the aft end is now directed into the engine crankshaft for drainage. Pressure in the forward end of the propeller dome forces the piston aft, unfeathering the blades. In flight, the blades immediately windmill and crank the engine. When the engine reaches the desired speed for starting, approximately 800 rpm, the feathering control switch must be released to stop the feathering pump. The distributor valve returns to its normal position and the transfer valve in the governor closes to shut off the feathering pump line, thus permitting the governor to resume its normal automatic control of engine speed when the engine is now started.

Note

> While the unfeathering operation has been described in the preceding paragraph as a flight condition to return the blades to normal operation and to crank the engine which are its normal functions, the ground test for unfeathering will be performed as described in paragraph 7.*b*.(4)*(b)* this section.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.

1. Remove accessory cowling as described in paragraph 5.*c*., this section.

2. Drain the oil from the drain cock. In the C-47, a drain cock is located forward of the fire wall on the side; on the C-47A, a "Y" drain cock is located forward of the fire wall at the lower center of the nacelle.

3. Disconnect the oil lines from the pump and drain them into a container.

4. Disconnect the electrical plug from the motor.

5. Detach hydraulic feathering pump from fire wall by removing attaching bolts which protrude forward through the pump base from the aft side of the fire wall. These bolts may be removed readily by working from within the main wheel well. Two men should work together in removing the auxiliary hydraulic feathering pump and electric motor assembly.

(b) DISASSEMBLY.—The feathering pump is to be disassembled only at depots.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Repairs to feathering pumps, with the exception of replacement of worn brushes, will be conducted at depots only.

(4) ADJUSTMENTS.—Adjustment of feathering pumps will be conducted at depots only.

(5) TEST BEFORE INSTALLATION.—Remove the two shipping plugs from the intake and discharge ports and test the pump to see that it will run freely. The pump should not be installed otherwise.

(6) ASSEMBLY AND INSTALLATION.

(a) ASSEMBLY. — Assembly of feathering pumps will be conducted at depots only.

(b) INSTALLATION.—Reverse of removal procedure. Refer to paragraph 7.*d*.(2), this section. Tighten all connections carefully to prevent leaks and see that all tubing is properly supported and bonded. Check to see that electrical connection to the motor is secure.

(7) TEST AFTER INSTALLATION.—For a complete description of the test after installation, refer to paragraph 7.*b*.(4)*(b)*, this section.

e. PROPELLER CONTROLS.

(1) DESCRIPTION.

(a) A push-button control switch is provided for each propeller feathering system. These switches are installed in the right- and left-hand electrical panels. Further description of these switches will be found in paragraph 14.*b*.(6)*(c)* and 14.*i*.(6), this section. Each of the two constant-speed control governors can be manually adjusted from the pilot's compartment. Adjustments are made with the engine rpm controls installed on the forward upper structure of the pilot's control pedestal. (See figure 258.) The purpose of these controls is to control the engine speed within the constant-speed range of 1200 rpm minimum to 2700 rpm maximum take-off speed. The function of these controls is to adjust the propeller governor, i.e., to increase or decrease the tension applied to the speeder spring within the governor head, thus regulating the flow of oil from the governor to the propeller to effect a change of blade angle, in this way regulating the speed of the engine to the desired rpm.

(b) It should be clearly borne in mind that with the constant-speed control governing, only the engine "RPM" controls (propeller-governor controls) can regulate engine speed. These controls do not regulate blade pitch. The abbreviation "RPM" designates these controls and their extreme positions are marked as follows: the forward control position is "INCREASE," signifying high rpm or low pitch range; the aft control position is "DECREASE," signifying low rpm or constant-speed high-limit range. The control system incorporates pulleys and cables from the control pedestal (figure 259) to the applicable constant-speed control governor pulley. Refer also to paragraph 7.*c*. (1), this section.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.—Disconnect first turnbuckles aft of the constant-speed control (propeller governor); then, in sequence, disconnect all cable turnbuckles, ending at the turnbuckles located nearest the control pedestal. When necessary, remove stops attaching cables to pulleys. No special tools are required for removal of the controls.

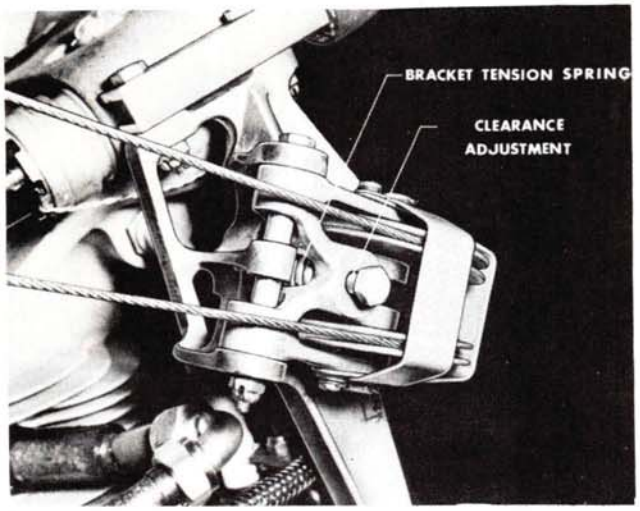


Figure 261—Propeller Control Engine Bracket

(b) DISASSEMBLY.—The propeller controls are disassembled when removed.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—Faulty control parts should be replaced rather than repaired.

(4) ADJUSTMENTS.

(a) Turn constant-speed control (propeller governor) pulley to "TAKE-OFF" position.

Note

The required rpm for take-off is 2700, or the maximum control limit of the constant-speed control governor. Therefore, the governor pulley is to be turned the maximum amount and then secured in this position by wire or other means.

(b) Push "RPM" control levers forward full amount.

(c) Loosen screws holding cables to drums installed in pedestal.

(d) Gradually increase tension of cables (extending from pedestal to differential pulley) by tightening all turnbuckles, beginning at the turnbuckles nearest the pedestal and working toward the differential pulley. Continue this procedure until the cable tension is in accordance with the cable tension chart (figure 336). (Refer to section IV, paragraph 12.) Use a tensiometer to determine tension of cables. *Make certain* that the stops attaching cables to the differential pulley are in the dead-center position, thus assuring complete travel of the cables in either direction.

(e) Tighten cables leading from the differential pulley to the constant-speed control propeller governor so that the spring, located under the pulley bracket (figure 261), is under sufficient compression to cause the bolt head to be ⅛ inch from the surface of the bracket. On airplanes having bolts with ⅝-inch hexagon heads installed in the bracket, the clearance adjustment is to be ¼ inch. These cables are not to be rigged in accordance with the cable rigging chart as such tension as therein specified may cause breakage of the cables due to engine vibration.

(f) Move "RPM" control levers ⅛ inch off "FULL RPM" position.

(g) Tighten screws holding cables to drums in pedestal.

(h) Remove wire which holds governor pulley in "HIGH RPM" or take-off position.

(5) TEST BEFORE INSTALLATION.—The control parts are not tested before installation.

(6) ASSEMBLY AND INSTALLATION. — Reverse the removal and disassembly procedures.

Note

The cables leading from the control pedestal are to be rigged in such a manner that when the "RPM" control levers are pulled aft toward the pilot ("DECREASE RPM") both governor pulleys will rotate in the same direction. (Counterclockwise when viewed from the front.)

(7) TEST AFTER INSTALLATION.—The engine "RPM" control (lever and cable linkage) is tested in conjunction with the test of the constant-speed control (propeller governor). Refer to paragraph 7.*c.*(6)*(b)* and *(c)*, this section. The propeller feathering control switch push button is tested in conjunction with the test of the hydraulic feathering pump and electric drive motor assembly. Refer to paragraph 7.*b.*(4)*(b)*, this section.

(8) MAJOR OVERHAUL.—Replace faulty control parts.

d. PROPELLER AND CONTROLS TROUBLE SHOOTING.

Trouble	*Probable Cause*	*Remedy*
INABILITY TO ATTAIN TAKE-OFF RPM ON THE BLOCKS.	Wrong setting of governor and incorrect rigging of control system.	Reset governor and rerig system.
	Improper adjustment of low-pitch stop ring in propeller dome assembly.	Reset stop ring.
	Low engine power.	See engine manual.

PROPELLER AND CONTROLS TROUBLE SHOOTING—Continued

Trouble	*Probable Cause*	*Remedy*
INABILITY TO ATTAIN TAKE-OFF RPM ON THE BLOCKS—Cont'd.	Erroneous reading on tachometers, manifold pressure gage.	Calibrate instruments.
OVERSPEEDING ON TAKE-OFF.	Wrong setting on governor and/or incorrect relationship between governor and engine rpm control (governor control).	Rerig and reset.
	Insufficient exercise of propeller mechanism prior to take-off.	Move engine rpm control through constant-speed range with engine running.
	Backlash in engine rpm control.	Rerig control system.
	Too rapid throttle opening.	Advance throttle slowly.
	Poor or incorrect gaskets between distributor valve and propeller shaft, and between governor base and engine mounting pad.	Install new gaskets.
	Sticky governor pilot or relief valve.	Disassemble and clean.
	High engine transfer ring leakage.	Replace rings according to engine manufacturer's specifications.
	Erroneous reading on tachometers, manipressure gage.	Calibrate instruments.
POOR SYNCHRONIZATION.	Ignition trouble.	Check with ignition tester or megger.
	Poor carburetion.	Consult engine carburetor manual.
	Backlash in governor control system.	Rerig control system.
	Sluggish pilot valve.	Disassemble and clean.
	Sluggish governor relief valve.	Disassemble and clean.
	Sticky piston action in propeller dome assembly.	Remove dome shell. Clean and lubricate piston gasket. If piston contact area of dome is scored, polish with wet and dry 300 emery.
	Loose piston gasket.	Tighten piston gasket nut.
	Variation in engine transfer ring leakage.	Replace rings.
LEAKAGE.	At crankshaft breather.	
	Incomplete engine scavenging or excessive blow-by.	Consult engine manual.
	Loose distributor valve.	Tighten distributor valve or engine shaft extension.
	Leaky gaskets.	Replace gaskets.
	Dome breather hole.	
	Damaged seal.	Replace seal.
	Loose spinner dome breather hole nut.	Tighten nut.
	Washer missing.	Install washer.
	Interference between breather pipe in propeller shaft and distributor valve oil transfer plate fillet.	Rework fillet.

PROPELLER AND CONTROLS TROUBLE SHOOTING—Continued

Trouble	*Probable Cause*	*Remedy*
LEAKAGE—Cont'd.	Dome retaining nut.	
	Damaged seal.	Replace seal.
	Loose nut.	Tighten nut.
	Blades.	
	Damaged packing or molded chafing ring.	Replace packing and molded chafing ring by split-type chafing ring.
	Barrel half seals.	
	Damaged seals.	Replace seals.
	Improper closure of barrel halves.	Remove burs from parting surfaces of barrel half.
	Barrel spider packing.	
	Damaged packing.	Replace packing.
	Rear cone.	
	Damaged spider shaft oil seal.	Replace seal.
	Spider shaft oil seal washer installed improperly.	Install in proper sequence—washer, seal, ring.
	Spider shaft oil seal washer missing.	Install washer.
	General.	
	Engine thrust plate seal.	Consult engine manual.
ROUGHNESS.	Spark plugs or ignition.	Replace spark plugs; check wiring.
	Propeller unbalance.	Check balance (effects will be greater at high rpm).
	Blade angles vary.	Correct angles (effects will be greater at high rpm).
	Ice on propeller.	Increase rpm for a short period.
	Engine part failure.	Feather propeller.
	Unknown cause.	Feather propeller.
FAILURE TO FEATHER.	Batteries low.	Recharge batteries.
	Faulty electrical system.	Check power and control circuits of feathering pump.
	Failure of push button to remain engaged.	Check wiring or low-pressure setting of cut-out switch.
	Failure to remain unfeathered.	
	Push button fails to disengage.	Reset cut-out switch.
	Incorrect high-pitch stop ring settings.	Reset stop ring.
	Sheared coupling in feathering pump.	Replace coupling.
	Restricted oil supply to feathering pump.	Check feathering pump inlet lines for foreign material; bleed line.
	Excessive leakage.	
	Improper distributor valve installation.	Check for tightness or interference.
	Poor or incorrect gaskets between distributor valve and propeller shaft, and between governor base engine mounting pad.	Install new gaskets.

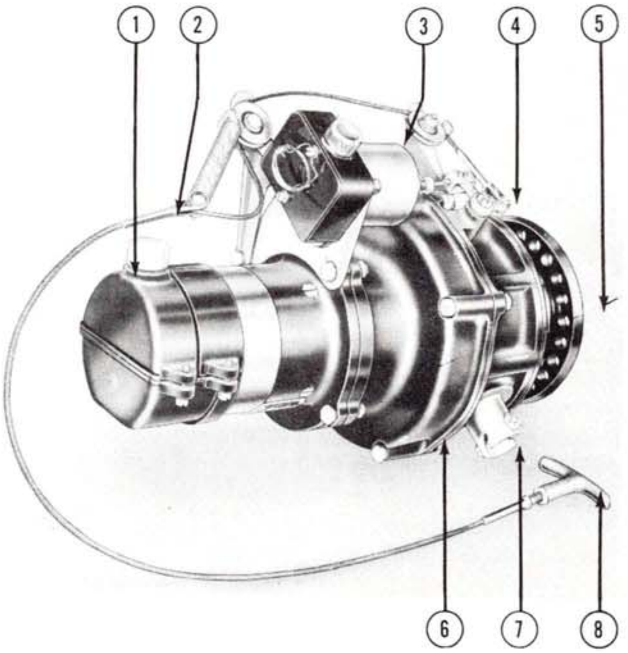


Figure 262—Starter (C-47)

1. Starter Motor
2. Manual Meshing Cable
3. Meshing Solenoid
4. Starting Meshing Cable Bell Crank
5. Mounting Flange
6. Starter Unit
7. Hand Crank Extension Receptacle
8. Manual Meshing Handle

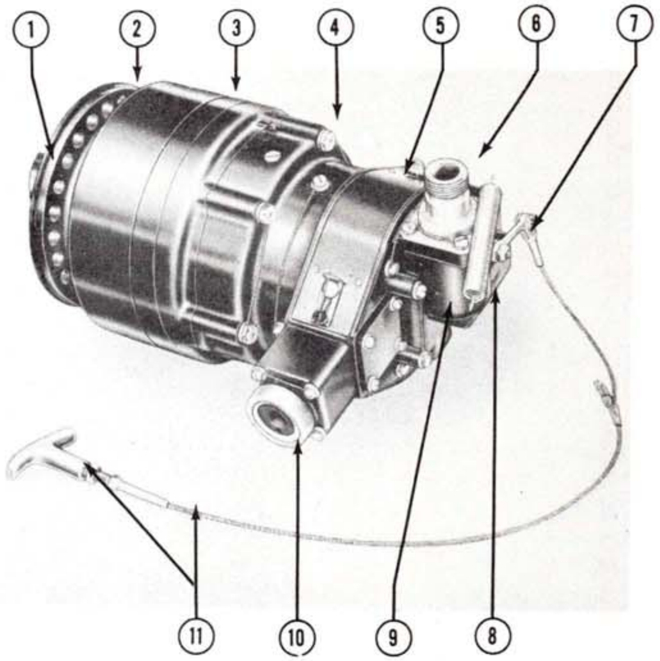


Figure 263—Starter (C-47A)

1. Starter Jaw
2. Mounting Flange
3. Base Unit
4. Motor Unit
5. Brush Cover Band
6. Hand Crank Flexible Cable Connection
7. Brush Lifting and Jaw Meshing Lever
8. Jaw Meshing Cable Spring
9. Jaw Meshing Solenoid
10. Electrical Receptacle
11. Manual Jaw Meshing Cable and Handle

8. STARTING SYSTEM.

a. DESCRIPTION.

(1) STARTERS. *(See figures 262 and 263.)*—On the C-47, a type C-21 electric inertia starter with solenoid meshing device is mounted on each engine. On the C-47A, a type G-6 or Jack & Heintz JH-3R, combination electric inertia, direct-cranking starter with solenoid device is mounted on each engine. The starters are operated by switches noted in the following paragraphs. External hand-starting controls incorporating a starter crank extension and a starting control cable are contained in each engine section for starting the engine by hand. (See figure 264.)

(2) STARTER SWITCHES.

(a) THE C-47 SYSTEM ONLY.—Two starter switches are located on the right-hand electrical panel. The "STARTER" switch is provided for energizing the starter; the "MESH" switch is for engaging the starter. Placing the switch in the "UPPER" position operates the starter and in the "DOWN" position operates the starter-engaging solenoid and the booster coil. The "OFF" position is midway between the two other positions.

(b) THE C-47A SYSTEM ONLY.—One starter switch and one mesh switch are located on the right-hand electrical panel. The "STARTER" switch is provided for energizing the starter and the "MESH" switch is for engaging the starter. Placing the energizing switch in the "DOWN" position energizes the right-hand starter, and in the "UPPER" position energizes the left-hand starter. Placing the "MESH" switch in the "DOWN" position meshes the right-hand starter, and placing the switch in the "UPPER" position meshes the left-hand starter. The "OFF" position is halfway between the two other positions.

(3) BOOSTER COIL.—On the C-47 airplane, an Eclipse battery-operated booster coil is mounted in a shielded case, installed on the upper inboard member of each engine mount. Flexible conduit is used to shield the leads from the case to one of the magnetos on the engine and between the two magnetos. On the C-47A airplane, an induction vibrator coil is installed on the upper inboard member of each engine mount. Flexible conduit is used to shield the leads.

(4) SOLENOID SWITCH.—A D-1 or B-8 solenoid switch is mounted in the junction box on the aft face of each fire wall.

Note

The C-1 solenoid switch is designed for con-

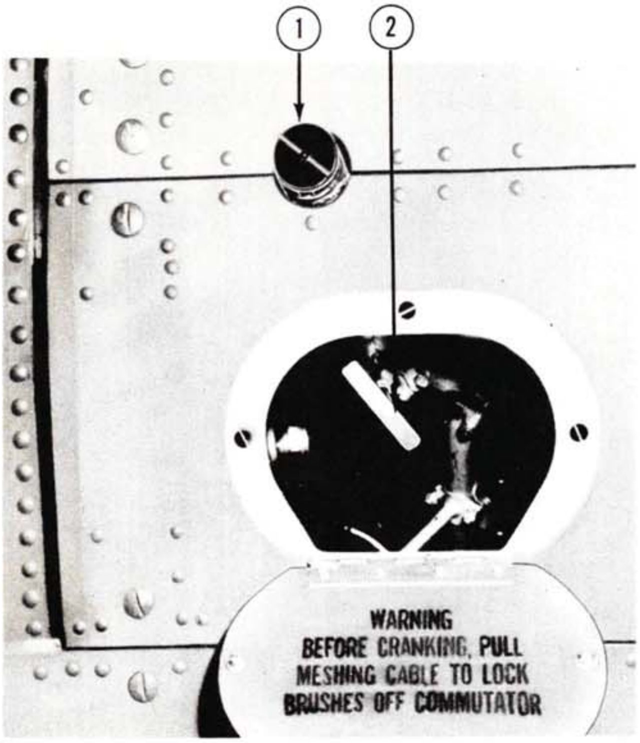


Figure 264—Starter Manual Operating Provisions

1. Hand Crank Receptacle
2. Meshing Cable Handle

tinuous duty and is not intended for use as a starter solenoid switch. Never substitute the C-1 for the D-1 solenoid switch, and vice versa.

b. MAINTENANCE OF STARTER.

Note

Starter repairs (other than exterior cleaning, and the replacement of brushes, complete starter motors, and field post nuts, and washers) and repairs on electric starter switches and booster coils will be performed only by engineering departments of air depots.

(1) TO REPLACE WORN-OUT STARTER BRUSHES.—Worn brushes should be replaced before their maximum wear limit is reached in order to insure proper operation between inspection periods. The maximum permissible brush wear is 5/32 inch. When replacing a worn brush, it is necessary to seat the brush properly by inserting a strip of No. 0000 sandpaper between the brush and commutator with sanded side next to the brush and pull in the direction of rotation. The operation should be repeated until the brush is 75 percent seated. Binding brushes and brush boxes should be wiped clean with a gasoline-moistened cloth. Worn brushes should be replaced immediately as burning of the commutator and insulation usually results from failure to make such replacement in time. Use caution, when installing brushes, by being sure the insulation around the brush leads is protecting the leads from the motor housing.

CAUTION

DO NOT USE COARSE SANDPAPER OR EMERY CLOTH. REMOVE SAND OR METAL PARTICLES WITH COMPRESSED AIR.

(2) ROUGH OR DIRTY COMMUTATOR.—If the commutator is rough or dirty, smooth it with No. 0000 sandpaper.

(3) BRUSH SPRINGS.—The brush springs should be replaced if the tension is less than 24 ounces or more than 28 ounces as measured where the spring leaves the top of a new brush.

c. MAINTENANCE OF SOLENOID SWITCH.—Replacement of defective D-1 solenoid switches will be made in the following order, depending on availability of stock:

First choice—B-8 relay switch.
Second choice—D-1 solenoid switch.

(1) When substituting the B-8 relay switch for the D-1 solenoid switch, it will be necessary to make cable and terminal arrangement between the switches. In making wire connections, use No. 0 cable.

(2) NO ATTEMPT WILL BE MADE BY SERVICE PERSONNEL TO TIGHTEN THE TERMINAL STUD NUTS WITHOUT REMOVING THE TERMINAL HOUSING COVER. An attempt to tighten this nut may twist the contact so that it will be shorted against the terminal housing. In cases where the terminal housing is removed, every precaution will be exercised to note that the insulating strips are installed correctly prior to assembly.

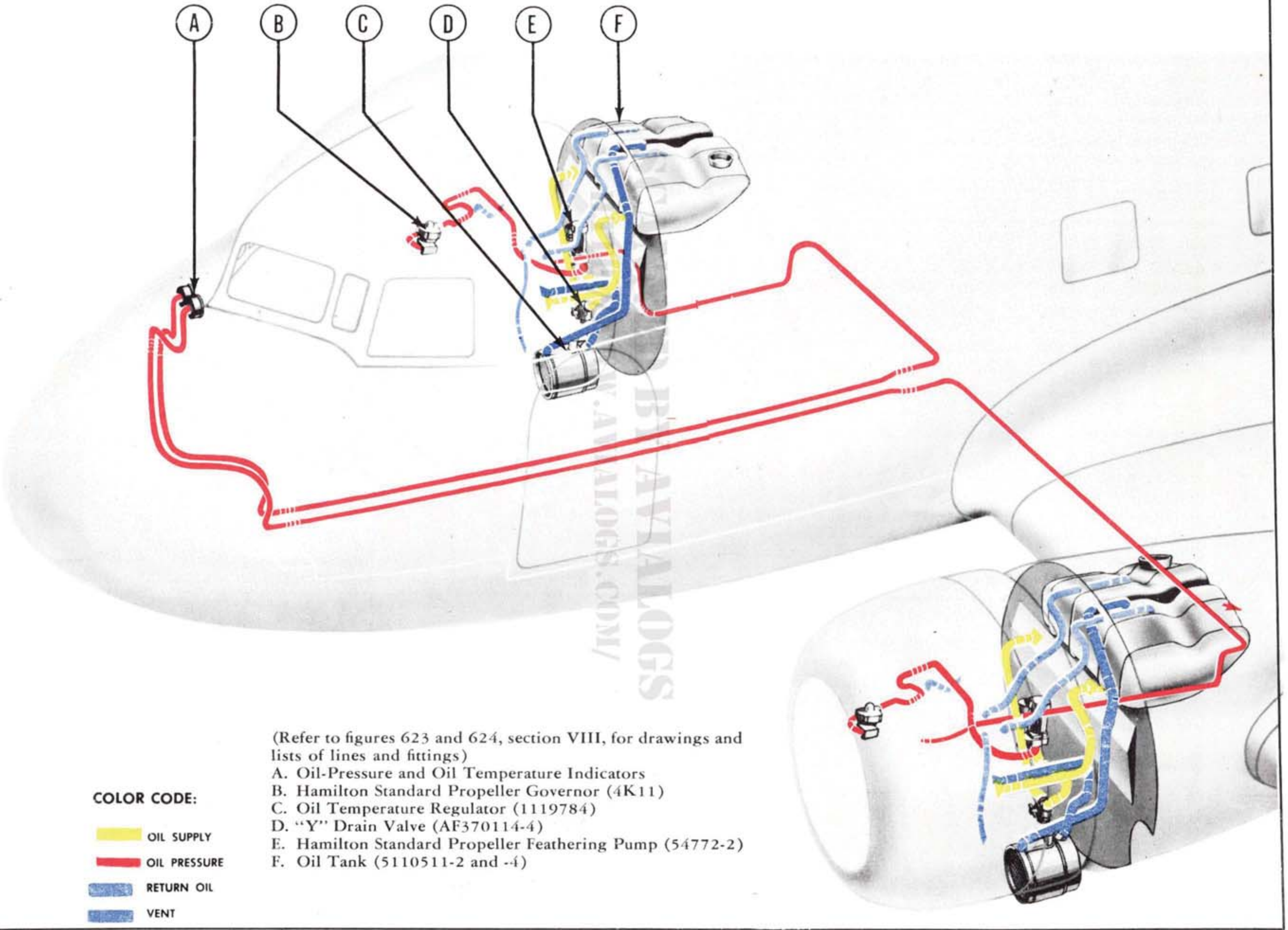
(3) Failure of either the solenoid or relay switches may result if an attempt is made to check the electrical equipment when the batteries are in a "poor" state of charge. If the power requirements of the equipment being checked should be high, the battery potential may drop below the value required to keep the solenoid or relay engaged. The circuit will then be opened. Immediately, the potential rises and the solenoid or relay closes the circuit. This cycle of operation is completed at a rapid rate and will continue until the load is removed or the operating switch is turned to the "OFF" position. The arcing which occurs during the rapid rate of operation will cause the solenoid or relay to fail in a short period of time.

d. INSTALLATION.—Before mounting the starter on the engine, remove the cover over the starter jaw.

Note

This cover is provided for shipping and storage purposes only.

To install the starter remove the engine crankcase plate and gasket covering the starter drive and mounting flange. Wipe the mounting flange clean and examine the end of the engine crankshaft to ascertain if the engine jaw and starter jaw are of the same type and are of the correct rotation for proper engagement.


A
B
C
D
E
F
COLOR CODE:
OIL SUPPLY
OIL PRESSURE
RETURN OIL
VENT

(Refer to figures 623 and 624, section VIII, for drawings and lists of lines and fittings)

A. Oil-Pressure and Oil Temperature Indicators
B. Hamilton Standard Propeller Governor (4K11)
C. Oil Temperature Regulator (1119784)
D. "Y" Drain Valve (AF370114-4)
E. Hamilton Standard Propeller Feathering Pump (54772-2)
F. Oil Tank (5110511-2 and -4)

Figure 265—Original C-47A Oil System

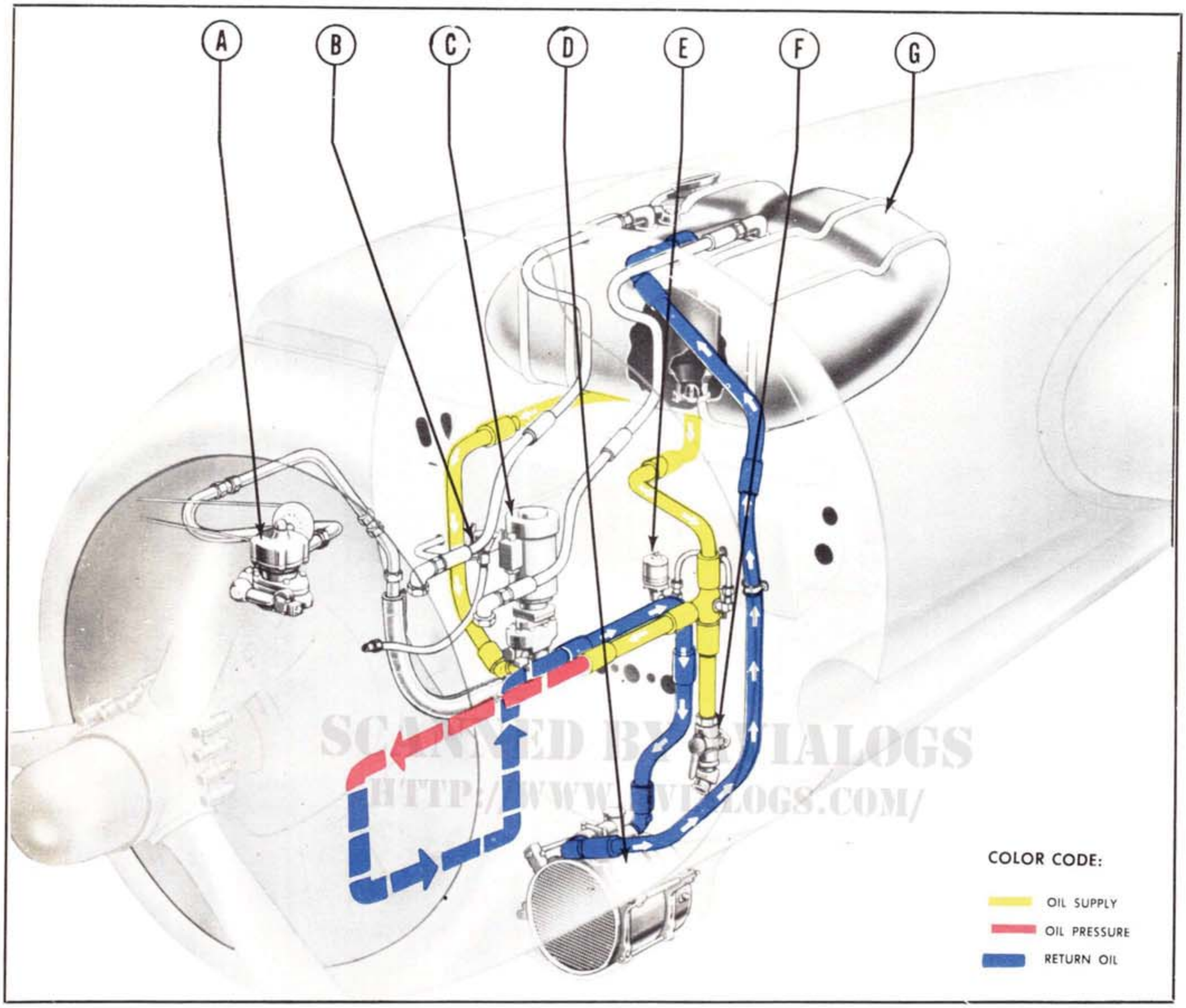


Figure 266—Original C-47 Oil System

(Refer to figure 625, section VIII, for drawing and list of lines and fittings)

A. Hamilton Standard Propeller Governor (4K11)
B. Pressure Warning Switch (Pioneer 3122-1)
C. Propeller Feather Pump (53535)
D. Oil Temperature Regulator (1119784)
E. Oil Dilution Solenoid Valve (AF370-6210)
F. Plug Drain Valve (Parker B7-741-2-1)
G. Oil Tank (5110511)

With the engine gasket removed, the distance from the mounting flange to the outermost part of the engine jaw must be 1-11/16 inches plus or minus 1/32 inch. The clearance between the engine jaw and starter jaw must be 3/32-inch minimum when the latter is fully retracted. Replace mounting flange gasket when mounting the starter.

e. OVERHAUL.—At a major overhaul, the starter, switches, and booster coils should be removed and forwarded to the depot for overhaul.

9. OIL SYSTEM.

(See figures 265 and 269.)

a. GENERAL.—Each engine section is provided with an independent oil system which has a capacity of approximately 34 U.S. (28.3 Imperial) gallons of oil. Of this capacity the tank holds 29 U.S. (24.1 Imperial) gallons, and the lines and engine hold approximately 5 U.S. (4.2 Imperial) gallons of oil.

(1) COMPONENTS.—The component parts of each oil system are as follows: an oil tank located in the nacelle (figure 270), an oil temperature regulator

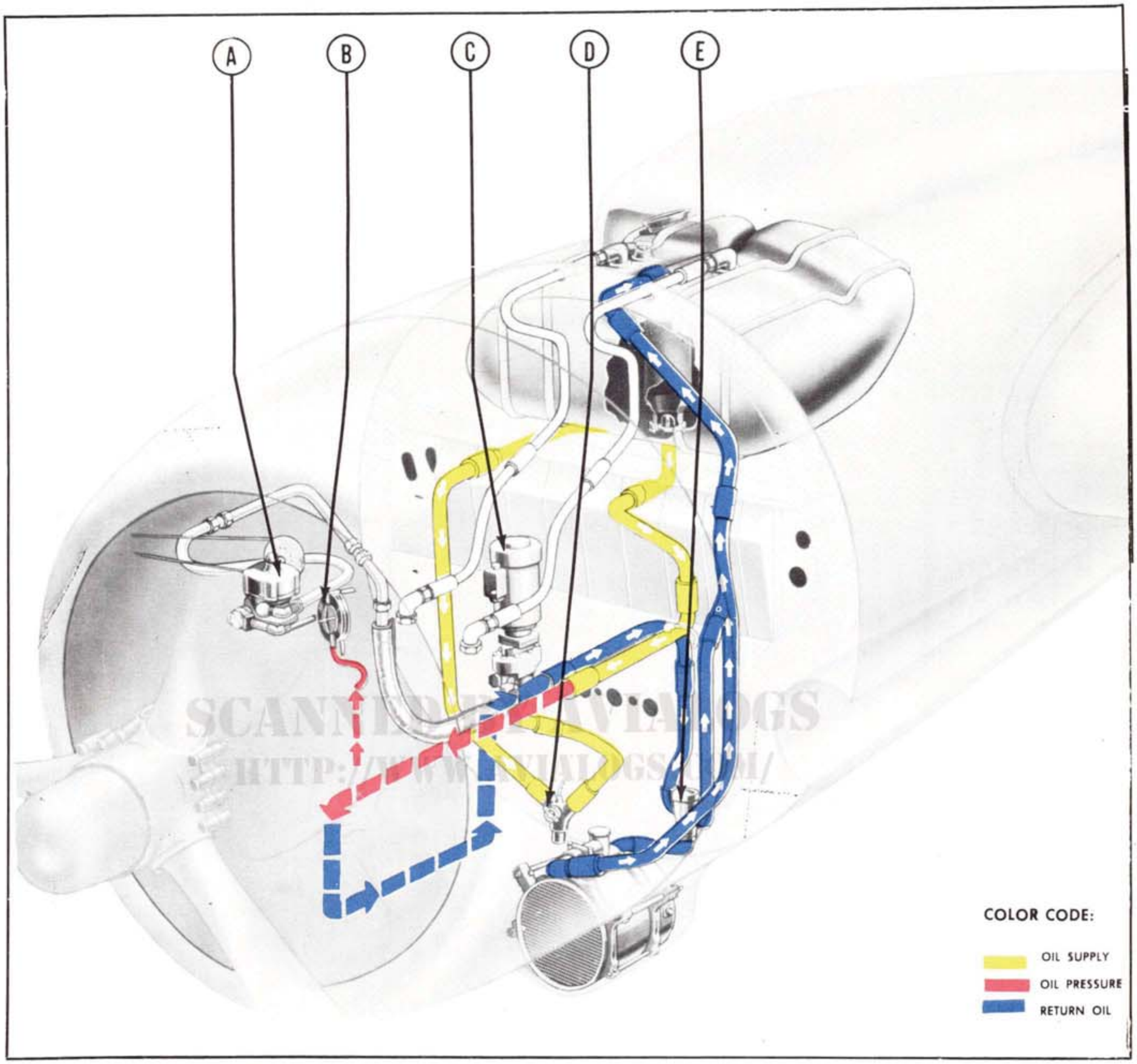


Figure 267—C-47A Oil System With Surge Valve on Fire Wall

(Refer to figure 626, section VIII, for drawing and list of lines and fittings)

A. Hamilton Standard Propeller Governor (4G-8-G-15D or 4K11-G0J)
B. Oil-Pressure Transmitter (Type A-1)
C. Propeller Feathering Pump (54772-2)
D. "Y" Drain Valve (K1400B-5)
E. Oil-Pressure Surge Valve (U-A-4400-1)

(oil cooler with valves and shutters) protruding from the under side of the nacelle, and the lines and fittings. The oil pump is an engine part, and the pressure, temperature, and warning equipment are to be considered part of the electrical or instrument systems. The oil-pressure indicator (figure 279) on some airplanes is to be considered a component of the oil system as it is of the direct-reading type, connected directly to an oil line.

(2) PURPOSE.—The purpose of the oil system is to lubricate and cool the engine, and to provide oil under pressure for the feathering of the propeller.

(3) FUNCTION.—Normal operation of the oil system for lubricating and cooling the engine is as follows: The oil is drawn from the tank through a line to the engine-driven pump. From here it is forced under pressure to all parts of the engine requiring lubrication. The oil, heated by the engine, flows down

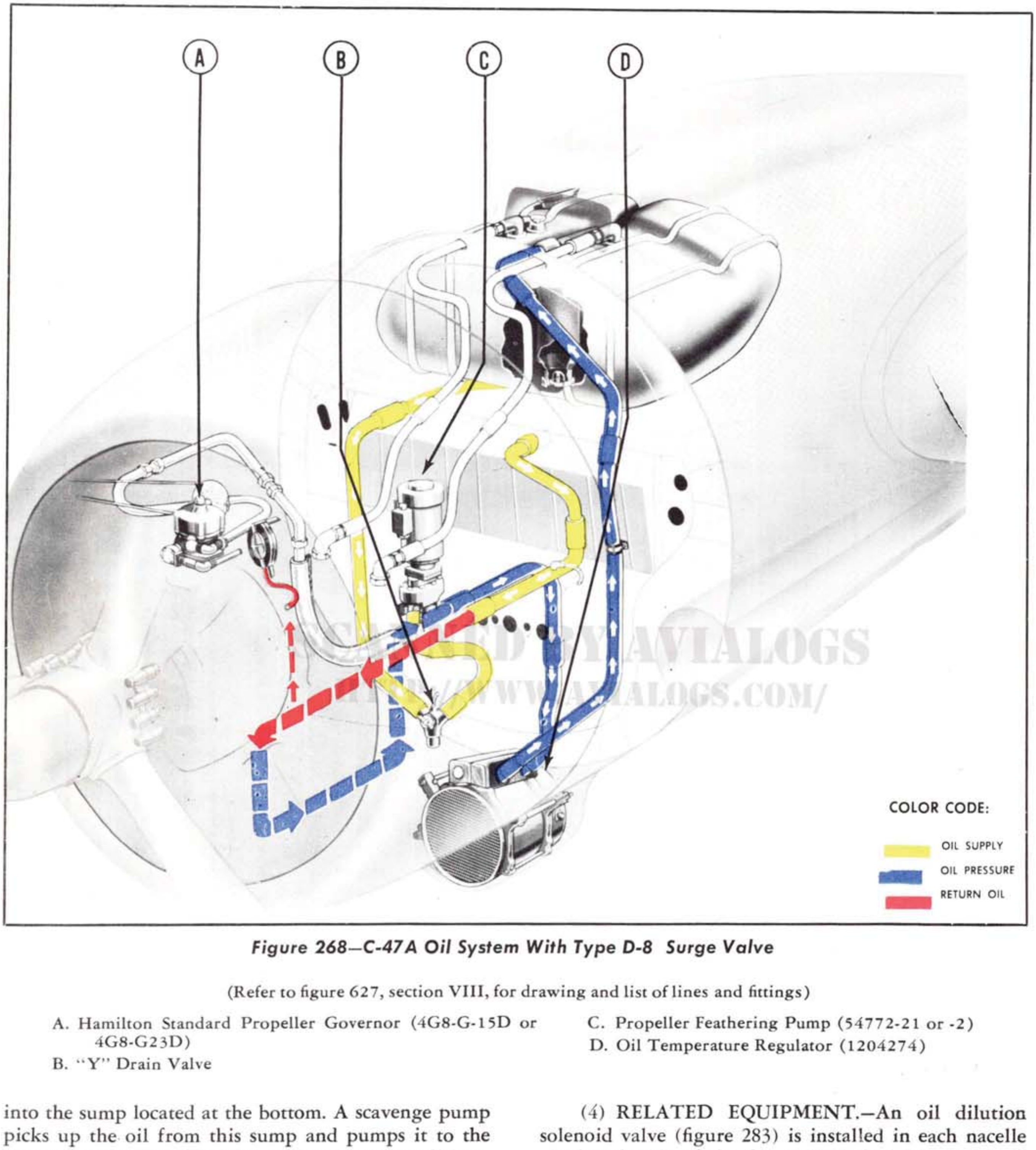


Figure 268—C-47A Oil System With Type D-8 Surge Valve

(Refer to figure 627, section VIII, for drawing and list of lines and fittings)

A. Hamilton Standard Propeller Governor (4G8-G-15D or 4G8-G23D)

B. "Y" Drain Valve

C. Propeller Feathering Pump (54772-21 or -2)

D. Oil Temperature Regulator (1204274)

into the sump located at the bottom. A scavenge pump picks up the oil from this sump and pumps it to the temperature regulator where, under normal conditions, it flows through the cores in the cooler. The heat from the oil dissipates through the thin copper wall of these cores into the airstream which flows through the cooler. The quantity of air flowing through the cooler cores can be regulated by controlling the cooler shutters from the pilots' compartment. These shutters are installed on the aft face of the oil cooler. A detailed description of the temperature regulator function may be found in paragraph 9.*e.,* this section.

(4) RELATED EQUIPMENT.—An oil dilution solenoid valve (figure 283) is installed in each nacelle on the aft side of the fire wall. A fuel system line is attached to the "IN" port and an oil system line to the "OUT" port of each of these valves. For cold weather operation the valve is opened, allowing a quantity of fuel to enter the oil system. This fuel thins the oil, decreasing the power required to start the engine, expedites the lubrication of the engine after it has started, and affords a quicker action of the propeller feathering system. When the engine heats up, the gasoline vaporizes and escapes through the crank-

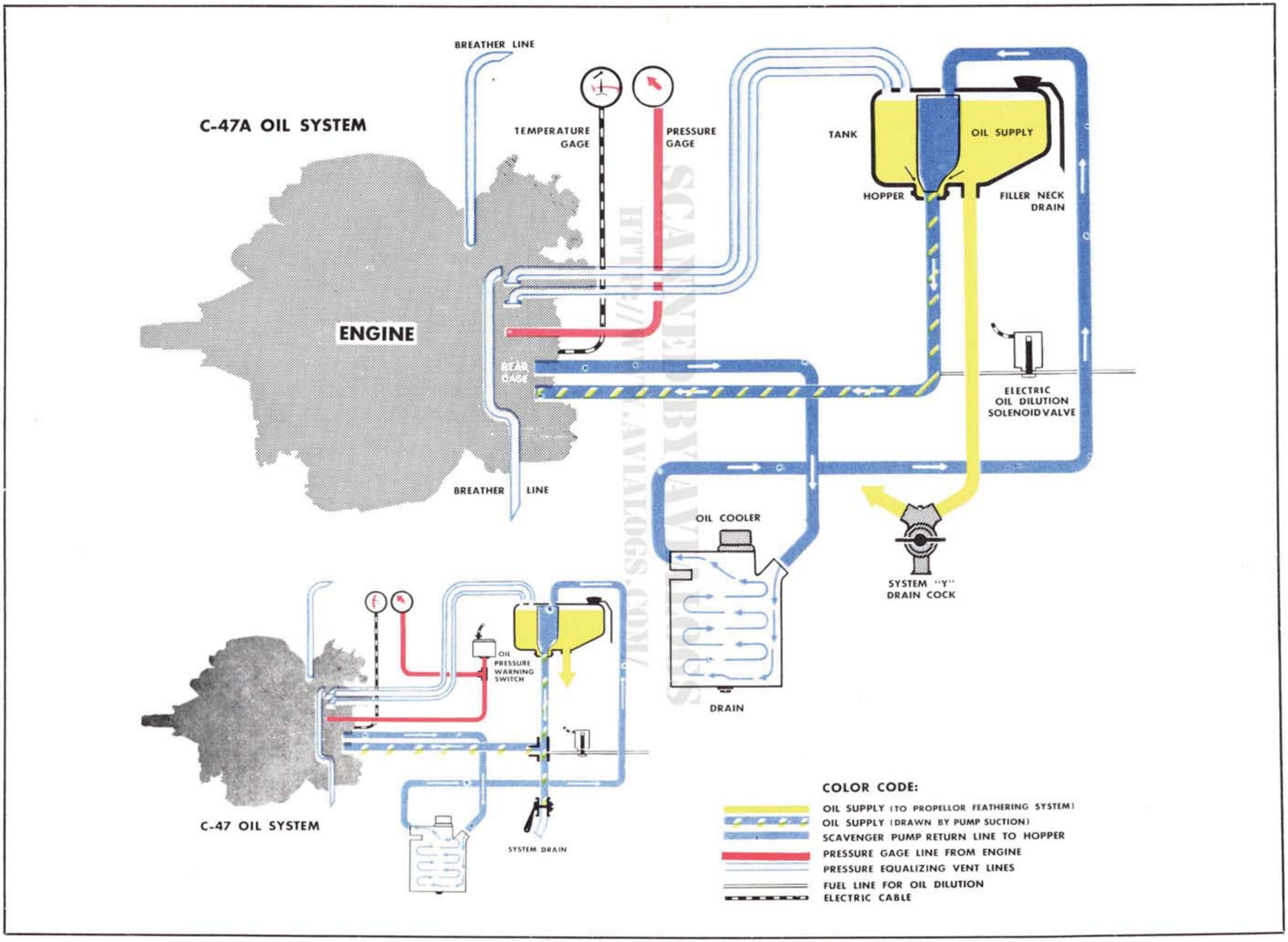

C-47A OIL SYSTEM
ENGINE
BREATHER LINE
TEMPERATURE GAGE
PRESSURE GAGE
TANK
OIL SUPPLY
HOPPER
FILLER NECK DRAIN
REAR CASE
ELECTRIC OIL DILUTION SOLENOID VALVE
BREATHER LINE
OIL COOLER
DRAIN
SYSTEM "Y" DRAIN COCK
C-47 OIL SYSTEM
OIL PRESSURE WARNING SWITCH
SYSTEM DRAIN
COLOR CODE:
OIL SUPPLY (TO PROPELLOR FEATHERING SYSTEM)
OIL SUPPLY (DRAWN BY PUMP SUCTION)
SCAVENGER PUMP RETURN LINE TO HOPPER
PRESSURE GAGE LINE FROM ENGINE
PRESSURE EQUALIZING VENT LINES
FUEL LINE FOR OIL DILUTION
ELECTRIC CABLE

Figure 269—Oil System Fluid Flow

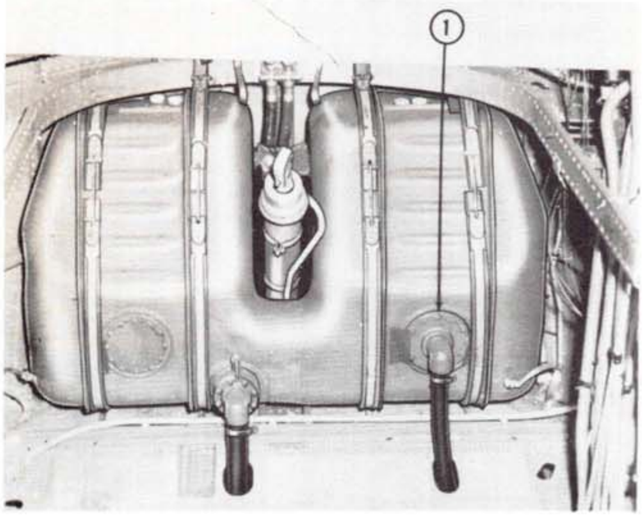


Figure 270—Oil Tank Installed

1. Outlet for Prop feathering—C-47B Airplanes

case vent, thus returning the oil to its normal viscosity. A dual pressure gage (on some airplanes two single gages) is installed on the instrument panel which indicates oil system pressure. During normal operation the oil system pressure is approximately 90 psi. The temperature indicator installation (on some airplanes a dual instrument, on others two single instruments) indicates to the pilot the temperature of the oil at the engine case. Normal oil temperature is 60 to 70°C (140 to 158°F). On some airplanes a red warning lamp, installed on the instrument panel, lights when the oil pressure drops below 50 psi.

b. FILLING THE SYSTEM.

(1) AFTER FLIGHT.

(a) Check the oil level in the tank with the measuring stick which may be removed as follows:

1. C-47A and early C-47B Airplanes.

a. Remove the screws from the panel (2, figure 273) at the rear of the air scoop and slide the air filter cartridge out about halfway.

b. Remove the cover plate (3, figure 273) on top of the air scoop and the right-hand cover plate inside the scoop.

c. Unscrew the head of the measuring stick from the fitting and pull out.

2. Late C-47B Airplanes have the dip stick fastened on the filler cap and the oil level can be checked when the filler cap is removed.

(b) Remove the cover plate above the filler well located just inboard of the scoop.

(c) Unscrew the filler well cap.

(d) Insert the filling hose into the filler well.

(e) Service the tank to approximately 25 U. S. (20.8 Imperial) gallons.

(f) Replace the filler cap and cover plate.

(g) On C-47A and early C-47B Airplanes replace the measuring rod, and fasten the measuring rod cover plate back in position. Slide the air filter cartridge back in position; replace the retaining panel and cover plate on the top of the air scoop.

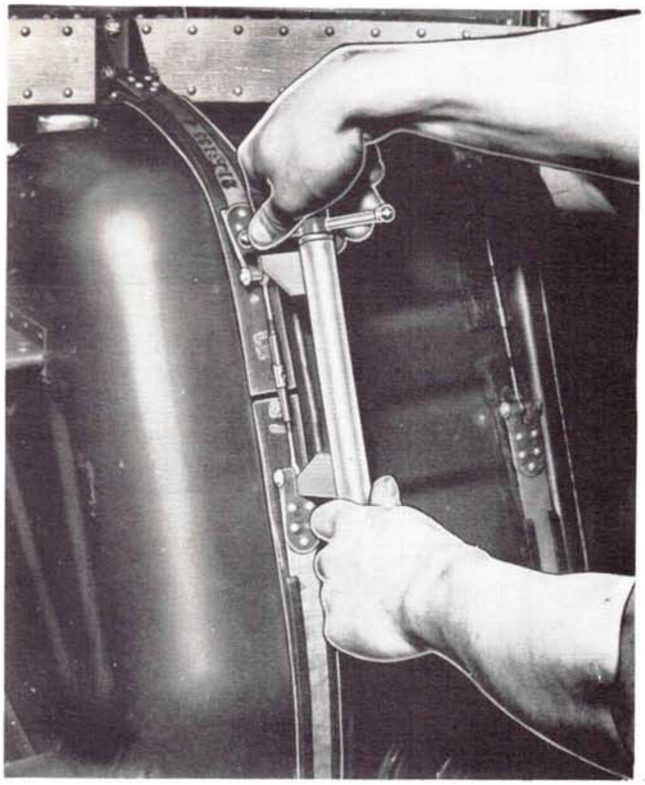


Figure 271—Use of Tank Strap Puller

(2) AT ENGINE CHANGE.

(a) Drain the system according to directions given in paragraph 9.*c.* following.

(b) Refill the system according to paragraph 9.*b.*(1) preceding.

(c) Eliminate all air bubbles from the line leading from the propeller feathering pump to the governor as follows:

1. Disconnect the line at the propeller governor and hold a vessel beneath the point of disconnection.

2. Making sure the "Y" drain or plug-type valve is closed; push the applicable propeller feathering button located in the pilots' compartment "IN." This energizes the switch which starts the pump.

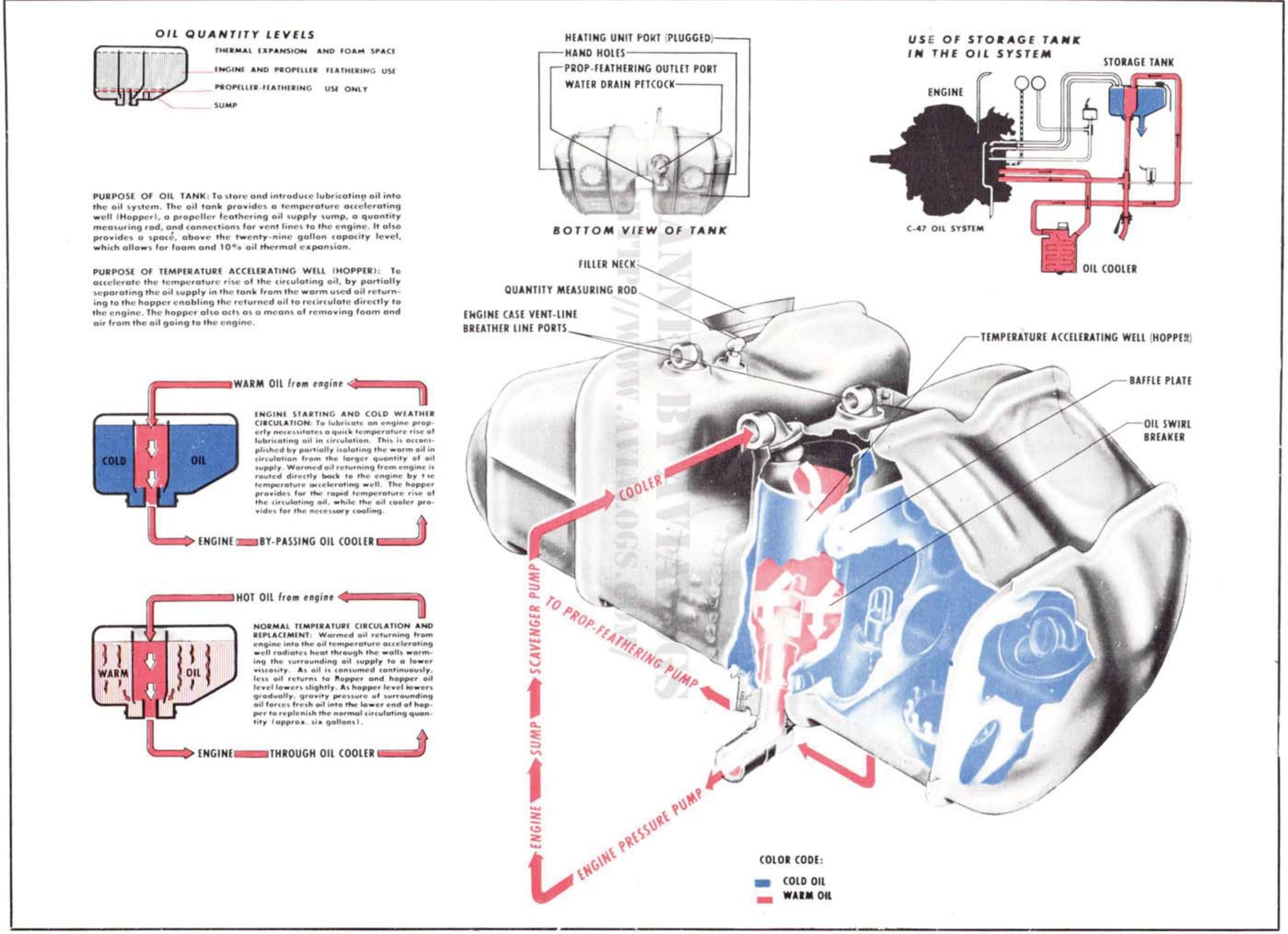
3. Watch for bubbles of air at this point.

4. When all air bubbles have disappeared, pull out the propeller feathering button, and reconnect the line.

c. DRAINING THE SYSTEM.

(1) Place a clean vessel under the "Y" drain or plug-type valve (whichever is installed); then, open the valve and allow all the oil to drain out.

(2) Open the draincock on the sump of the oil tank and drain the sump.


OIL QUANTITY LEVELS
THERMAL EXPANSION AND FOAM SPACE
ENGINE AND PROPELLER FEATHERING USE
PROPELLER-FEATHERING USE ONLY
SUMP
HEATING UNIT PORT (PLUGGED)
HAND HOLES
PROP-FEATHERING OUTLET PORT
WATER DRAIN PETCOCK
BOTTOM VIEW OF TANK
USE OF STORAGE TANK IN THE OIL SYSTEM
ENGINE
STORAGE TANK
C-47 OIL SYSTEM
OIL COOLER
FILLER NECK
QUANTITY MEASURING ROD
ENGINE CASE VENT-LINE BREATHER LINE PORTS
TEMPERATURE ACCELERATING WELL (HOPPER)
BAFFLE PLATE
OIL SWIRL BREAKER
COOLER
TO PROP-FEATHERING PUMP
SCAVENGER PUMP
SUMP
ENGINE
ENGINE PRESSURE PUMP
COLOR CODE:
COLD OIL
WARM OIL
WARM OIL from engine
COLD
OIL
ENGINE
BY-PASSING OIL COOLER
HOT OIL from engine
WARM
OIL
ENGINE
THROUGH OIL COOLER

PURPOSE OF OIL TANK: To store and introduce lubricating oil into the oil system. The oil tank provides a temperature accelerating well (Hopper), a propeller feathering oil supply sump, a quantity measuring rod, and connections for vent lines to the engine. It also provides a space, above the twenty-nine gallon capacity level, which allows for foam and 10% oil thermal expansion.

PURPOSE OF TEMPERATURE ACCELERATING WELL (HOPPER): To accelerate the temperature rise of the circulating oil, by partially separating the oil supply in the tank from the warm used oil returning to the hopper enabling the returned oil to recirculate directly to the engine. The hopper also acts as a means of removing foam and air from the oil going to the engine.

ENGINE STARTING AND COLD WEATHER CIRCULATION: To lubricate an engine properly necessitates a quick temperature rise of lubricating oil in circulation. This is accomplished by partially isolating the warm oil in circulation from the larger quantity of oil supply. Warmed oil returning from engine is routed directly back to the engine by the temperature accelerating well. The hopper provides for the rapid temperature rise of the circulating oil, while the oil cooler provides for the necessary cooling.

NORMAL TEMPERATURE CIRCULATION AND REPLACEMENT: Warmed oil returning from engine into the oil temperature accelerating well radiates heat through the walls warming the surrounding oil supply to a lower viscosity. As oil is consumed continuously, less oil returns to hopper and hopper oil level lowers slightly. As hopper level lowers gradually, gravity pressure of surrounding oil forces fresh oil into the lower end of hopper to replenish the normal circulating quantity (approx. six gallons).

Figure 272—Oil Tank Diagram

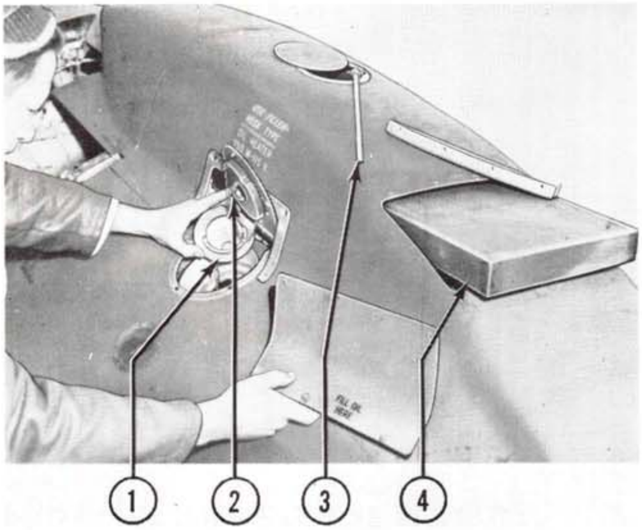


Figure 273—Access Plates to Oil Tank

1. Oil Tank Filler Cap
2. Oil Tank Access Plate
3. Dip Stick and Dip Stick Access Panel
4. Carburetor Air Scoop Filter

(3) Disconnect the propeller feathering line from the pump to the engine at the elbow on the pump. (See figure 285.)

(4) Open the drain plug on the oil cooler and drain all the oil into a clean vessel.

(5) Drain the oil from the engine according to directions given in paragraph 6.*b*.(1)*(b)*3., this section.

d. OIL TANKS. *(See figure 270.)*

(1) DESCRIPTION.—A 29 U. S. (24.1 Imperial) gallon metal tank is installed in each nacelle, aft of the fire wall. The tank is saddle shape in appearance to allow clearance for the landing gear retracting strut which it straddles. Baffles (figure 272) within the tank prevent the oil from sloshing back and forth during flight. A temperature accelerating well (hopper) is installed in each tank. Return oil from the engine goes into this well to partially isolate it from the rest of the oil supply, enabling this returned oil to recirculate directly to the engine. This hopper also acts as a means of removing foam and air from the oil going to the engine. Fuel diluted oil remains in the well (hopper) and is thus insulated from the undiluted oil. The use of hopper-type tanks will require less time to vaporize the fuel and return the oil to normal viscosity. A standpipe which is installed in the oil tanks sump, on some airplanes, holds a reserve of oil which is available only to the propeller feathering pump. A filler well is attached to the top of each tank. Overflow oil is drained from this filler well to the outside of the nacelle through a drain tube attached to the well. A drain cock (F, figure 266) is provided on the tank sump. On C-47A and early C-47B Airplanes a quantity measuring rod screws into the top of the tank adjacent to the right-hand vent port. On late C-47B Airplanes the Measuring Rod is installed on the filler cap. On some airplanes, provisions for an oil immersion heater is installed which includes electric wiring in the airplane, and a casting in the bottom of the tank into which the heater is inserted. On the other airplanes, the flexible-type oil immersion heater must be inserted through the filler well. In some of these airplanes, a wooden adapter ring for holding the flexible heater in the filler well is stowed inside the filler door. On C-47B Airplanes the wooden adapter ring is replaced by a metal adapter ring.

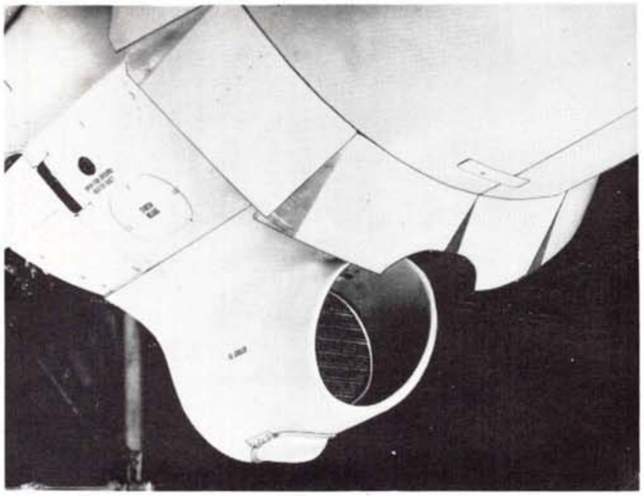


Figure 274—Oil Temperature Regulator Installed

(2) REMOVAL.

(a) Drain the oil tank according to the procedure described in paragraph 9.*c.,* preceding.

(b) Remove the metal ring from the synthetic rubber overflow drain tube end of the outside of the nacelle.

(c) Disconnect and plug all lines.

(d) Detach the bonding strips.

(e) Remove the tank cross braces (figure 270) above the landing gear retracting strut.

(f) Cut the lock wire and unscrew the turnbuckles, releasing the tank retaining straps.

(g) Lower the tank down and out.

(3) (Deleted)

(4) ASSEMBLY AND INSTALLATION.—Reverse the removal procedure, observing the following note.

Note

Tighten the strap turnbuckles securely but not so tightly that the straps are under a strain. (See figure 271.)

e. OIL TEMPERATURE REGULATORS.

(1) DESCRIPTION.—An oil temperature regulator assembly protrudes from each nacelle, aft and below the engine section. On the C-47 and C-47A airplanes, three different regulator assemblies have been installed:

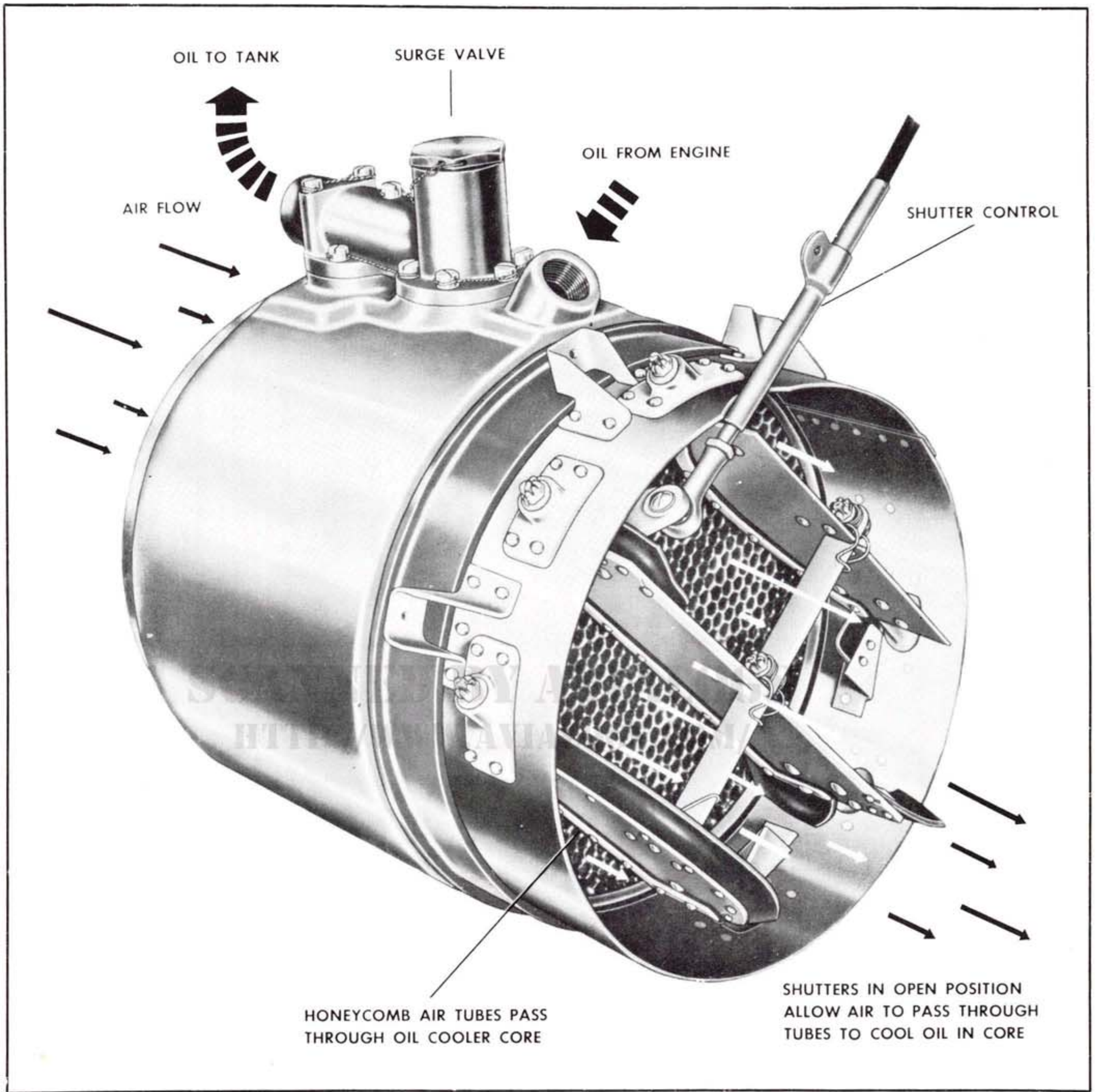

OIL TO TANK
SURGE VALVE
OIL FROM ENGINE
AIR FLOW
SHUTTER CONTROL
HONEYCOMB AIR TUBES PASS THROUGH OIL COOLER CORE
SHUTTERS IN OPEN POSITION ALLOW AIR TO PASS THROUGH TUBES TO COOL OIL IN CORE

Figure 275—Oil Temperature Regulator

The first type used (D, figure 266) is an assembly consisting of an oil cooler, oil cooler shutters, and a pressure relief valve. Normally, the heated engine oil flows through the cooler cores where heat dissipation to the air stream returns the oil to a higher viscosity. During cold weather operation, oil in the cooler cores becomes congealed, thus restricting normal oil flow and causing a rise in the system pressure. As high pressure will damage the thin-walled copper cores, a pressure relief valve is installed, which bypasses the high-pressure oil around the warming jacket (muff) of the cooler. When the oil in the cooler becomes warm, normal flow through the core becomes possible, causing the pressure to drop and the relief valve to close.

The second type used (figure 267) is identical to the first except for a surge valve (E, figure 267) which prevents surges of high pressure from reaching the cooler. During a surge of high pressure the oil is bypassed through this valve directly from the engine to the tank.

The third type used (figure 281) is identical to the second except for a spring-type thermostatic element, which replaces the pressure relief valve. This element routes the oil through the warming jacket

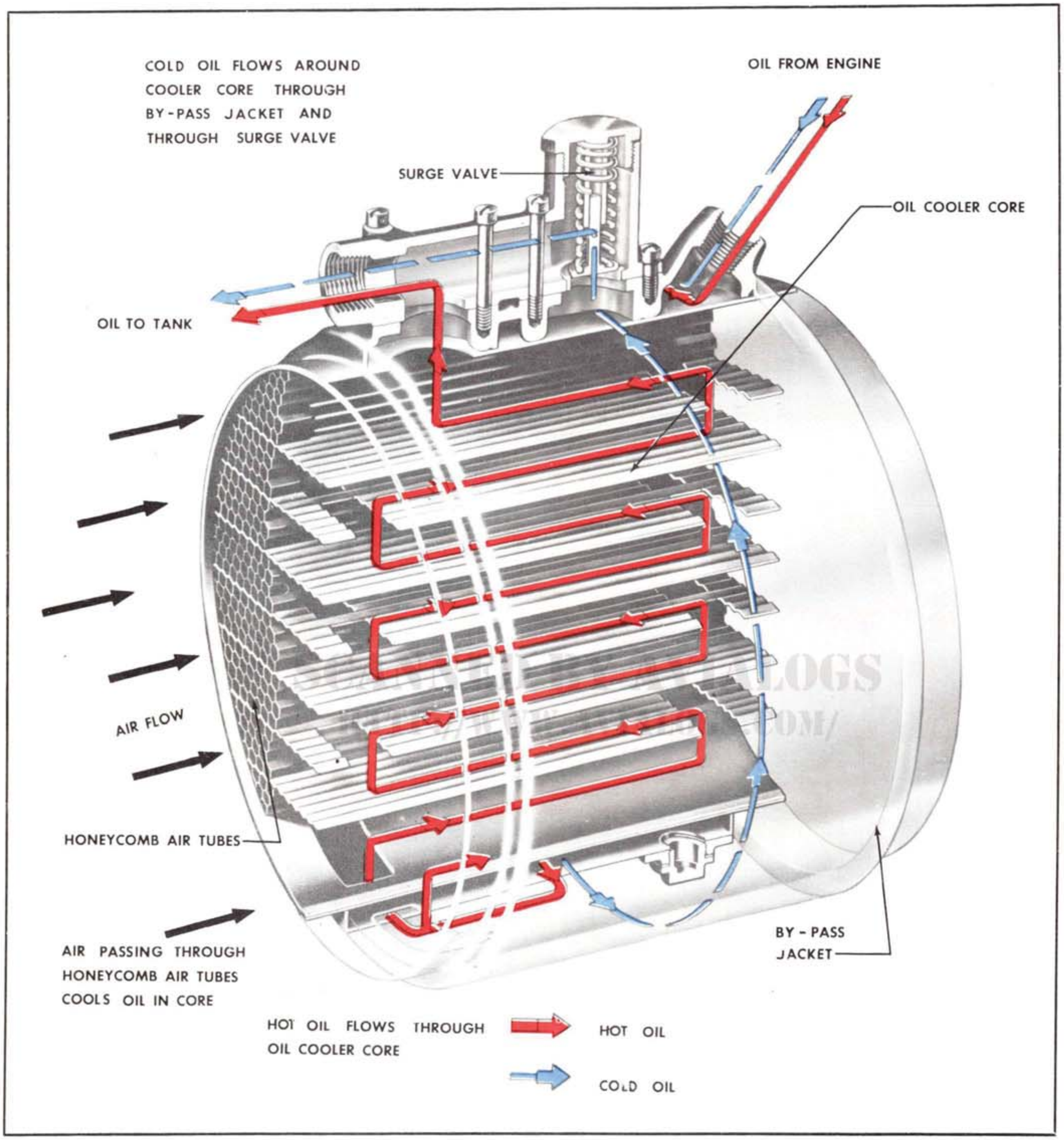

COLD OIL FLOWS AROUND COOLER CORE THROUGH BY-PASS JACKET AND THROUGH SURGE VALVE
OIL FROM ENGINE
SURGE VALVE
OIL COOLER CORE
OIL TO TANK
AIR FLOW
HONEYCOMB AIR TUBES
AIR PASSING THROUGH HONEYCOMB AIR TUBES COOLS OIL IN CORE
BY-PASS JACKET
HOT OIL FLOWS THROUGH OIL COOLER CORE
HOT OIL
COLD OIL

Figure 276—Oil Temperature Regulator Cutaway View

(muff) of the cooler when the oil in the cores is below 68°C (154°F).

(a) OIL COOLER.—The oil cooler (figures 274 and 275) is an airstream radiator which cools the heated oil returning from the engine. The cooler is composed of a shell (figure 276), an outer warming jacket (muff), a core separated by baffles, and a mounting flange for pressure control valves. Air flows through the core of the cooler, passing out through the shutters attached to the rear. The core, honey-comb-like in external appearance, is a bundle of copper tubes arranged in such a manner that hot oil, flowing around the tubes, radiates its heat to the air stream. Because the hexagonal ends of the tubes are bonded together with solder, the core of the cooler actually becomes a leak-proof container through which air (through tubes) and oil (surrounding the tubes) circulate freely. This cooling action lowers the temperature of the oil to a

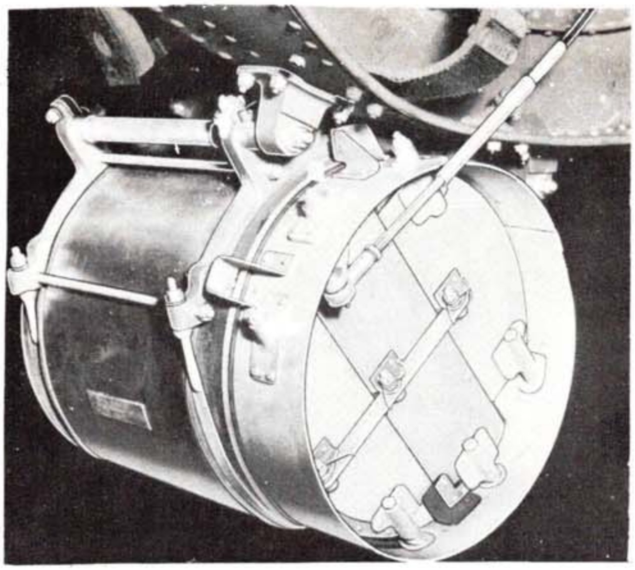


Figure 277—Oil Temperature Regulator (Shutters Closed)

degree suitable for normal engine operation. To prevent a channeling of the oil from one end of the core to the other with consequent partial cooling of the oil, a series of baffles divides the core bundle into compartments with openings at alternate ends. Thus, the oil is forced to traverse all the tubes in one compartment before passing through slots into the next. The baffles also furnish strength to withstand thermal stresses and hydraulic pressures. The "free-flow," or internal warming feature, on some airplanes speeds the warm-up of oil thickened in the cooler during cold weather. This is accomplished by a design in the construction of the cooler which allows low-pressure flow paths to be set up for the oil.

(b) CONTROL VALVES.—The oil cooler cores are of such thin construction that high pressures in the oil system would cause damage to these cores. To prevent oil under high pressure from entering them, a valve (or valves) is installed to route the oil either around the warming jacket (muff) of the cooler or through a line that bypasses the cooler completely. These valves are described as follows:

1. PRESSURE RELIEF VALVE.—This valve is installed on the oil cooler of all airplanes not equipped with the thermostatic relief valve. Where the oil pressure drop in the oil cooler cores exceeds 32 psi, the valve opens, routing the oil through the cooler warming jacket (muff) to the tank.

2. SURGE PROTECTION VALVE. *(See figures 280 and 282.)*—This valve is installed (on some airplanes) as an added protection of the oil cooler against high pressure. Surges of pressure, greater than can be safely overcome by the relief valve, are relieved through this valve. At 55 psi the "OUT" port to the tank line starts to open. Simultaneously the port to the cooler starts to close. At 70 to 100 psi the tank port is wide open and the cooler port is completely closed. On some of the airplanes in which this valve is used it is installed upon the fire wall; on others it is an integral part of the oil temperature regulator.

3. THERMOSTATIC VALVE. *(See figure 282.)*—On some airplanes a thermostatic valve is installed as an integral part of the oil temperature regulator. At oil temperatures below 68°C (154°F), the cooler warming jacket (muff) port is open, allowing the oil to bypass the cooler cores. When the temperature rises to 76 to 80°C (168 to 176°F) the thermostatic bellows expand and close all the warming jacket (muff) port, thus compelling the oil to flow through the cores. Pressure can override the force of these bellows and open the muff port if for any reason flow through the cores is restricted.

4. CHECK VALVE.—A check valve is installed to prevent surge relief oil from backing up into the cooler and damaging the cores. This check valve is of the poppet-type, installed in the same housing as the surge protection and thermostatic valves. A check valve will be found only on the airplanes equipped with the thermostatic valve.

(c) SHUTTER ASSEMBLY.—The shutters (figure 278), manually adjustable by handles on the control pedestal in the pilots' compartment, consist of three blades which are opened or closed by the pilot as necessary to maintain a desired oil temperature.

(2) REMOVAL AND DISASSEMBLY.

(a) REMOVAL.

1. Remove the combination scoop and fairing (figure 274) by loosening the Dzus fasteners.

2. Drain the oil cooler through the drain cock or plug on the bottom. (See figure 281.)

3. Disconnect the two lines from the oil inlet and outlet ports and insert plugs in the open ends.

4. Disconnect the shutter control at the fitting on the center shutter.

5. Remove the brackets holding the cooler.

(b) DISASSEMBLY.

1. Unbolt the supports and metal straps.

2. Remove the four bolts and the protective synthetic rubber strips from the shutter assembly.

3. Remove the valve assembly from the valve mounting flange.

Note

Because the cooler is built as an integral unit, it should not be disassembled.

(3) MAINTENANCE REPAIR OR REPLACEMENT.—If the cooler tubes are collapsed or if the shell is dented seriously, replace; return the damaged regulator to a depot for repairs. If only a few tubes are damaged, proceed with temporary repairs as described following:

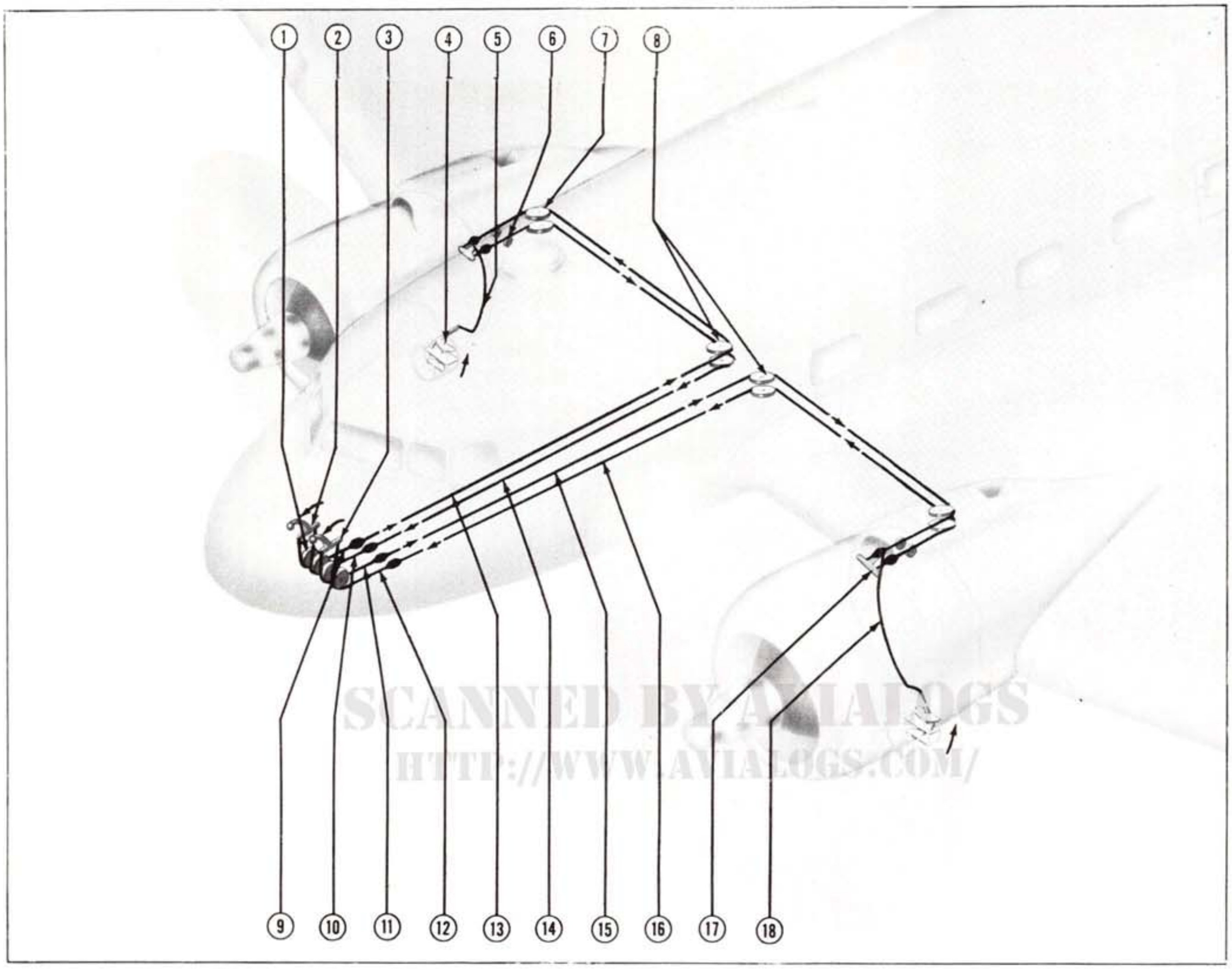


Figure 278—Oil Temperature Regulator Shutter Controls

Item	*Part No.*	*Part Name*	*No. Req* *LH*	*RH*
1	AN210-2A	Pulley	2	2
2	2116161	Lever		1
3	2116162	Lever	1	
4	1119784 or	Oil Temperature	1	1
	1204274	Regulator	1	1
5	2119041-1	Control		1
6	AN210-1A	Pulley	2	2
7	AN210-2A	Pulley	2	2
8	AN210-2A	Pulley	2	2
9	2115277-16	Cable		1
10	2115277-14	Cable		1
11	2115277-12	Cable	1	
12	2115277-10	Cable	1	
13	4114029-41	Cable		1
14	4114029-39	Cable		1
15	4114029-33	Cable	1	
16	4114029-31	Cable	1	
17	2119041	Control	1	
18	1117723	Bell Crank	1	1

(a) SMALL CORE LEAK.

1. Place a steel washer and then a relatively thick synthetic rubber washer on a long bolt.

2. Push the bolt through the leaking tube, and apply the remaining parts in the following sequence: a synthetic rubber washer, a flat steel washer, lock washer, and stop nut.

3. Tighten the bolt or nut securely.

(b) LARGE CORE LEAKS.

1. Make two large patches which will adequately cover the leaking tubes at both ends of the cooler.

Note

The metal portions of these patches should be made of rigid metal material, the thickness depending upon the degree of rigidity. The part of the patch covering the cooler must be made of relatively thick synthetic rubber and of the same dimensions as the metal patch covering it on the outside.

2. Drill holes for the bolt through one of the metal patches.

Note

This patch may be used as a template for drilling the remaining patch. Square or rectangular patches should always be drilled near the rounded-off corners; additional holes may be drilled, if necessary.

3. Insert the long bolts through the holes in one of the metal patches and one of the synthetic rubber patches.

4. Push the bolts through the core tubes so that the leaking area is covered adequately.

5. Slide the synthetic rubber patch and the metal patch onto the bolt ends.

6. Add the lock washers and stop nuts and tighten them securely.

(c) WARMING JACKET BYPASS SHELL LEAKS.

1. Prepare a synthetic rubber patch and a metal patch to cover the affected area. This metal patch should not be as rigid as the patch described in the preceding paragraph, nor should the synthetic rubber be as thick. Round patches are the most suitable.

2. Drill the outer edges of the patch simultaneously to secure alignment of the holes.

3. Bend the metal patch to conform to the contour of the shell, permitting the patch to be used as a template for punching holes into the jacket.

Note

DO NOT DRILL INTO THE SHELL. Use a short pointed punch to prevent metal chips from entering the cooler as these chips may hinder the operation of the control valves.

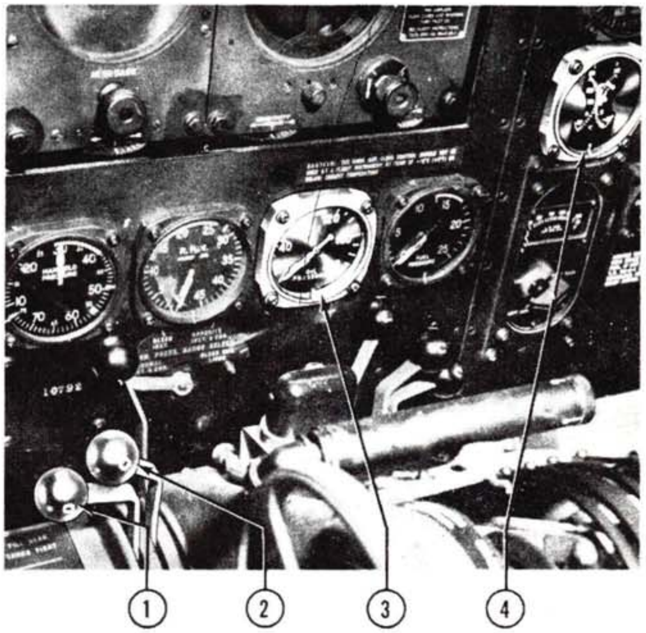


Figure 279—Oil System Control Levers and Instruments

1. Oil Cooler Shutters Control Lever (Left Engine)
2. Oil Cooler Shutters Control Lever (Right Engine)
3. Oil-Pressure Indicator
4. Oil Temperature Indicator

4. Fasten the synthetic rubber and metal patch to the shell securely with blunt-end sheet metal screws (not over 5/16 inch in length).

(d) CLEANING THE REGULATOR.—If metal particles have collected in the regulator, remove the regulator and return to a major overhaul depot for rebuilding. If sludge has collected in the regulator, proceed as follows:

1. Remove the regulator from the airplane, and detach the valve housing from the valve mounting flange.

2. Fill the regulator with benzol, and slosh the solution back and forth sufficiently to loosen the sludge.

3. Drain the regulator through the drain cock on the bottom; reinstall on the airplane.

(4) ASSEMBLY AND INSTALLATION.—Reverse the procedure described in removal and disassembly, taking particular care not to damage the cooler.

f. OIL COOLER SHUTTER CONTROLS.—Installed on C-47A and early C-47B airplanes only. (See figure 278.)

(1) DESCRIPTION.—Each cooler has a set of shutter controls consisting of a flexible rod or Arens control, connecting the shutters to the bell crank on the aft side of the fire wall, and cables extending from the bell cranks to the right- and left-hand control levers in the pilots' compartment. Each set of control levers has notched washers which hold the controls in any "SET" position. The controls, located on the left top side of the control pedestal are identified by the marking "O"

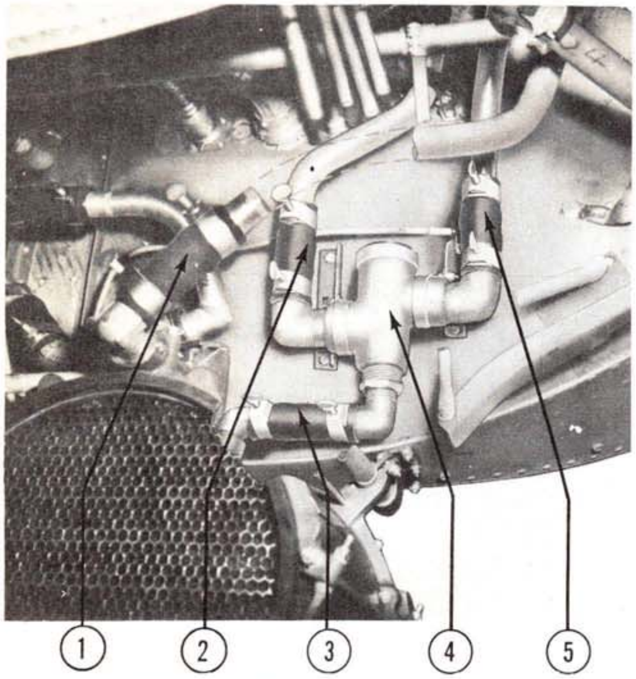


Figure 280—Surge Valve Installed on Fire Wall

1. Oil Line—Cooler to Tank
2. Propeller Governor to Surge Valve
3. Surge Valve to Oil Cooler
4. Surge Valve (U-A-4400-1)
5. Surge Valve to Tank

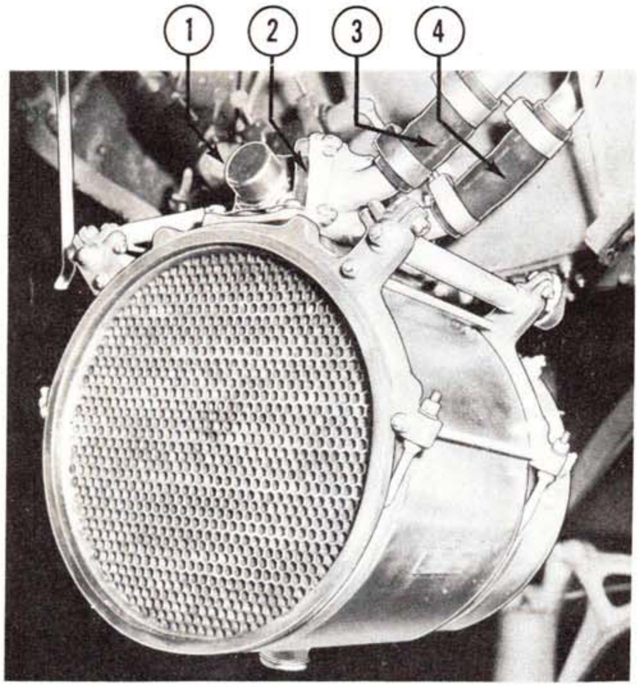


Figure 281—Oil Temperature Regulator With Type D-8 Surge Valve

1. Type D-8 Surge Valve
2. Bracket (2062673)
3. Oil Return Line—Cooler to Tank
4. Oil Inlet—Engine to Cooler

on the knob. A forward movement of the control lever opens the shutters; an aft movement closes them.

(2) REMOVAL AND DISASSEMBLY. *(See figure 278.)*

(a) Break the lock wire on the turnbuckles and disconnect the cables at the turnbuckles near the bell crank in each nacelle.

(b) Remove the center floor panel aft of the control pedestal.

(c) Working through this opening, disconnect the clevis and pin connections.

(d) Remove the guard pins from the pulley cluster in the center wing. This pulley cluster may be reached through the selector-valve access holes located at the forward edge of the center wing section to the left and right of the airplane center line.

(e) Pull the shutter control cable through the pulley cluster into the nacelle.

CAUTION

Pull the cables through the pulley cluster slowly and carefully so that there is no danger of chipping the Micarta pulleys.

(3) MAINTENANCE REPAIR AND REPLACEMENT.

(a) Examine all rod-bearing ends for freedom of movement and replace if found faulty.

(b) Inspect all pulleys; replace those found to be damaged.

(c) Check all cables and replace those which have more than six wires broken in any 1-inch length. (Replace any cables with broken wires which travel over a pulley.)

(4) ASSEMBLY AND INSTALLATION. – Reverse the procedure described in removal and disassembly preceding, observing the following precautions:

(a) Be sure the turnbuckle barrel does not touch the bell crank.

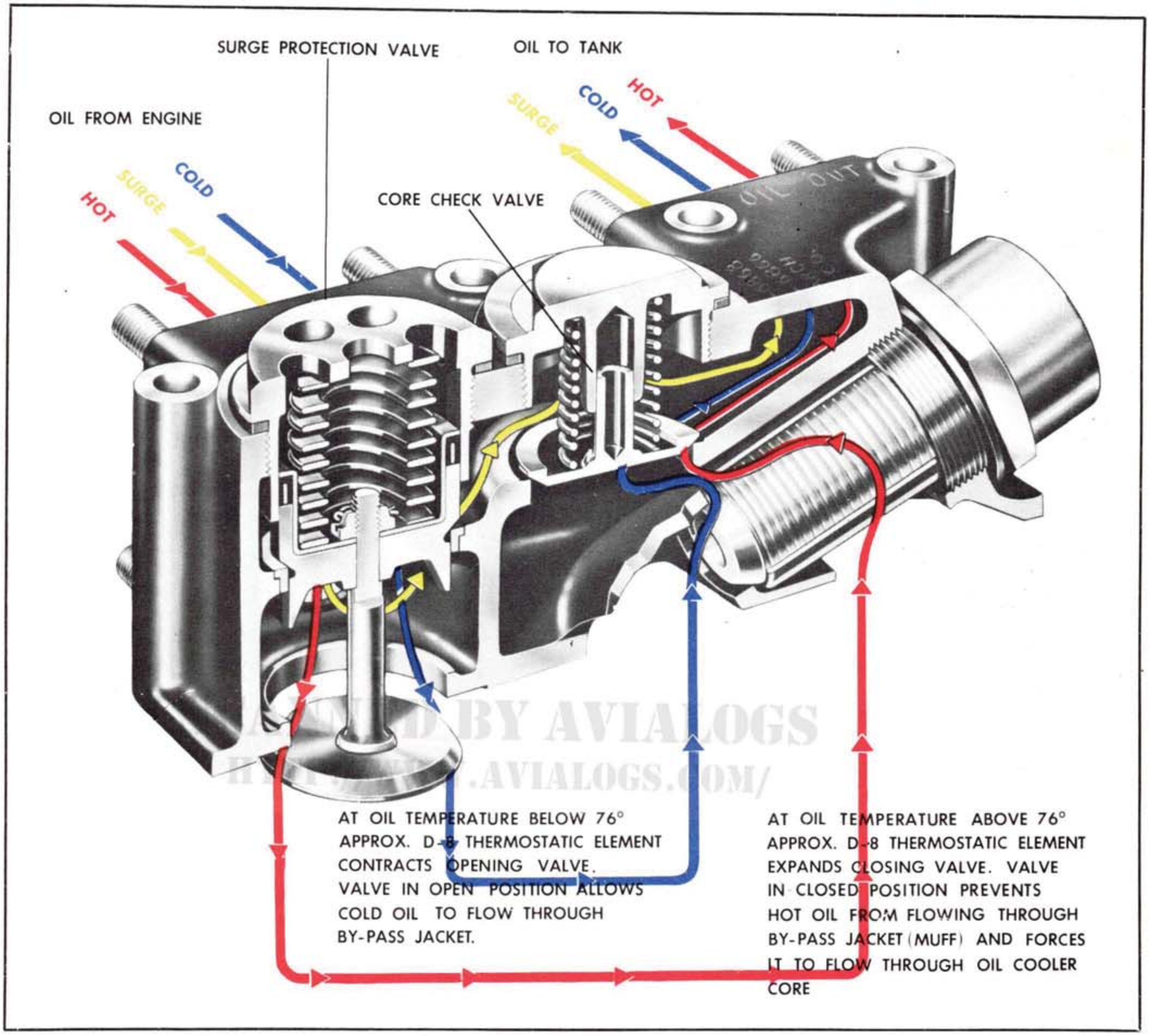
(b) Be sure the shutters close tightly when the shutter controls are in the "AFT" position.

(c) Be sure there is no spring-back at the ends of the Arens control.

(d) Be sure there is no clearance at the forward end of the shutter control levers, and not more than 1/8 inch at the opposite end.

g. LINES AND CONNECTIONS.

(1) DESCRIPTION. – The lines of aluminum alloy may be divided into four classes: suction (tank to engine-driven oil pump), propeller feathering, return (engine to tank), breather and vent lines. See section VIII for a chart showing the installation of lines.



AT OIL TEMPERATURE BELOW 76° APPROX. D-8 THERMOSTATIC ELEMENT CONTRACTS OPENING VALVE. VALVE IN OPEN POSITION ALLOWS COLD OIL TO FLOW THROUGH BY-PASS JACKET.

AT OIL TEMPERATURE ABOVE 76° APPROX. D-8 THERMOSTATIC ELEMENT EXPANDS CLOSING VALVE. VALVE IN CLOSED POSITION PREVENTS HOT OIL FROM FLOWING THROUGH BY-PASS JACKET (MUFF) AND FORCES IT TO FLOW THROUGH OIL COOLER CORE

Figure 282—Type D-8 Surge Valve Cutaway View

(2) REMOVAL AND DISASSEMBLY.

(a) Be sure the system or the affected parts of the system are drained.

(b) Remove or disconnect the clamps, hose, and fittings from the lines being removed.

(c) Put sealing caps over the ends of all exposed lines to prevent foreign particles from entering them.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) Remove, clean, and check all lines and hose for scratches or deformity.

(b) Remove slight scratches with a fine grade of emery cloth and oil.

(4) ASSEMBLY AND INSTALLATION.—Reverse the procedure described in removal and disassembly, observing the following precautions:

(a) Be sure oil-inlet thermometer connection provides a tight joint.

(b) Be sure all connections are sufficiently tight. At least 1 inch of a hose should overlap a bead of a line to allow sufficient area for the hose clamp.

(c) Be sure the hose clamps have some take-up left.

h. PROPELLER FEATHERING SYSTEM. *(See figure 285.)*—The oil for this system is taken through a fitting on the bottom of the tank. The oil is routed to the propeller governor (constant-speed control) where the pressure is boosted for propeller feathering. For a detailed description of the propeller feathering system see paragraph 7.*c.* and *d.,* this section.

i. PRESSURE TRANSMITTER. *(See figure 284.)*—The oil-pressure transmitter, mounted on the rear case of the engine (if installed), is used for measuring and

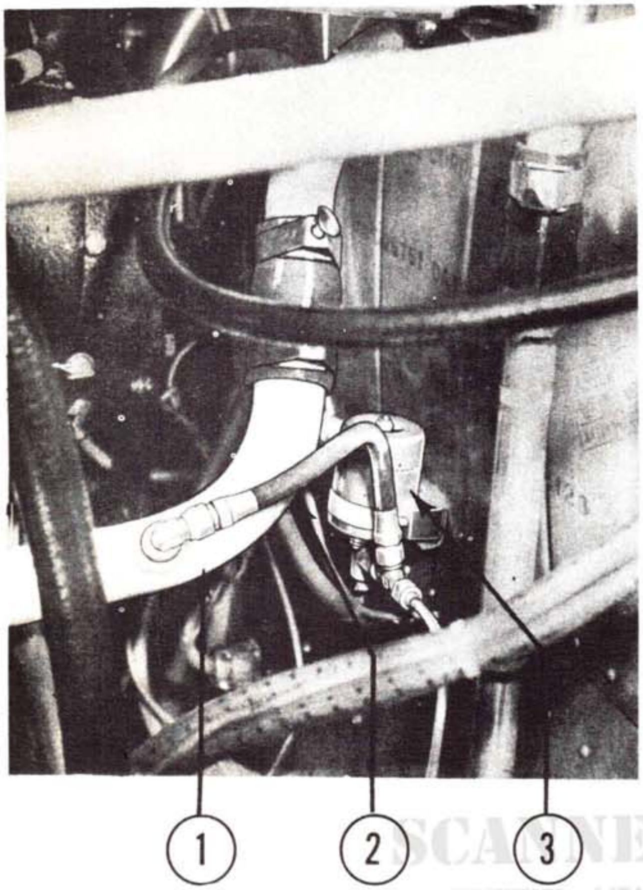


Figure 283—Oil Dilution Fuel Lines

1. Oil Supply Line
2. Oil Dilution Fuel Line
3. Oil Dilution Solenoid Valve

indicating pressures, providing remote indication on the instrument panel. The transmitter has a bowl, separated into two chambers by a diaphragm of corrugated synthetic rubber. One chamber is connected directly to the oil source and the other is part of a closed system which is connected to the indicating gage. The entire system, including the chamber, gage, and connecting lines, is filled with compass fluid. Changes in pressure are transmitted through the compass fluid to the gage and are indicated on the dial. This transmitter eliminates the necessity for running oil lines into the cockpit, and insures operation of gages without the time lag which might be caused by oil congealing. For details on removal and maintenance see paragraph 11.*e.*, this section.

j. OIL DILUTION SOLENOID VALVE. *(See figure 283.)*—An electrically-operated oil dilution solenoid valve, mounted on the fire wall, enables fuel to flow into the oil in the propeller feathering and the engine inlet lines. Thus, when a cold start is anticipated, the oil dilution switch energizes the solenoid which lifts the valve, allowing fuel to pass into the propeller feathering line and the engine inlet line. For more details, see paragraph 14.*i.*(5), "Electrical System."

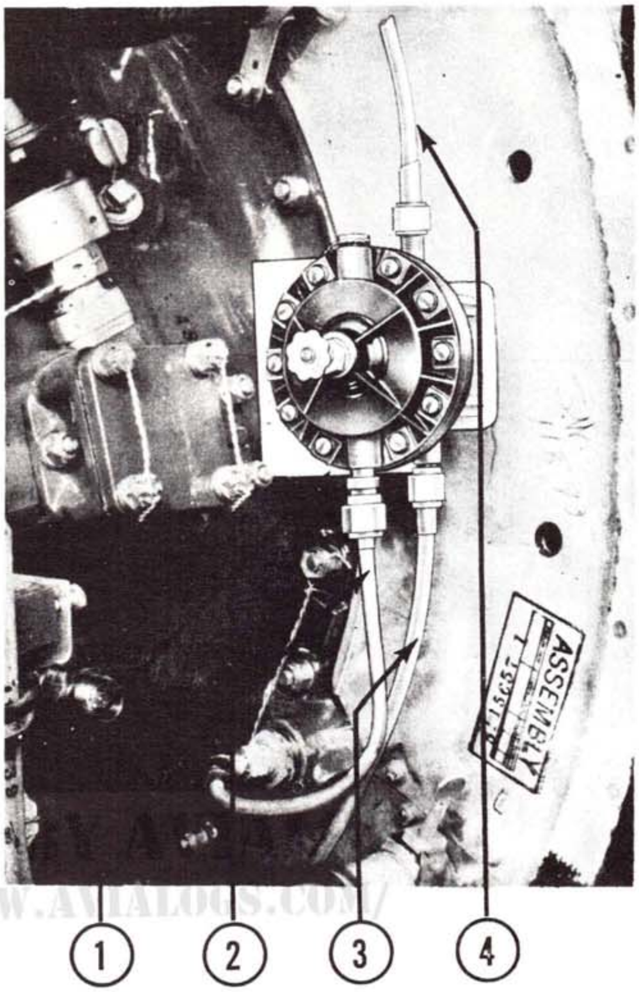
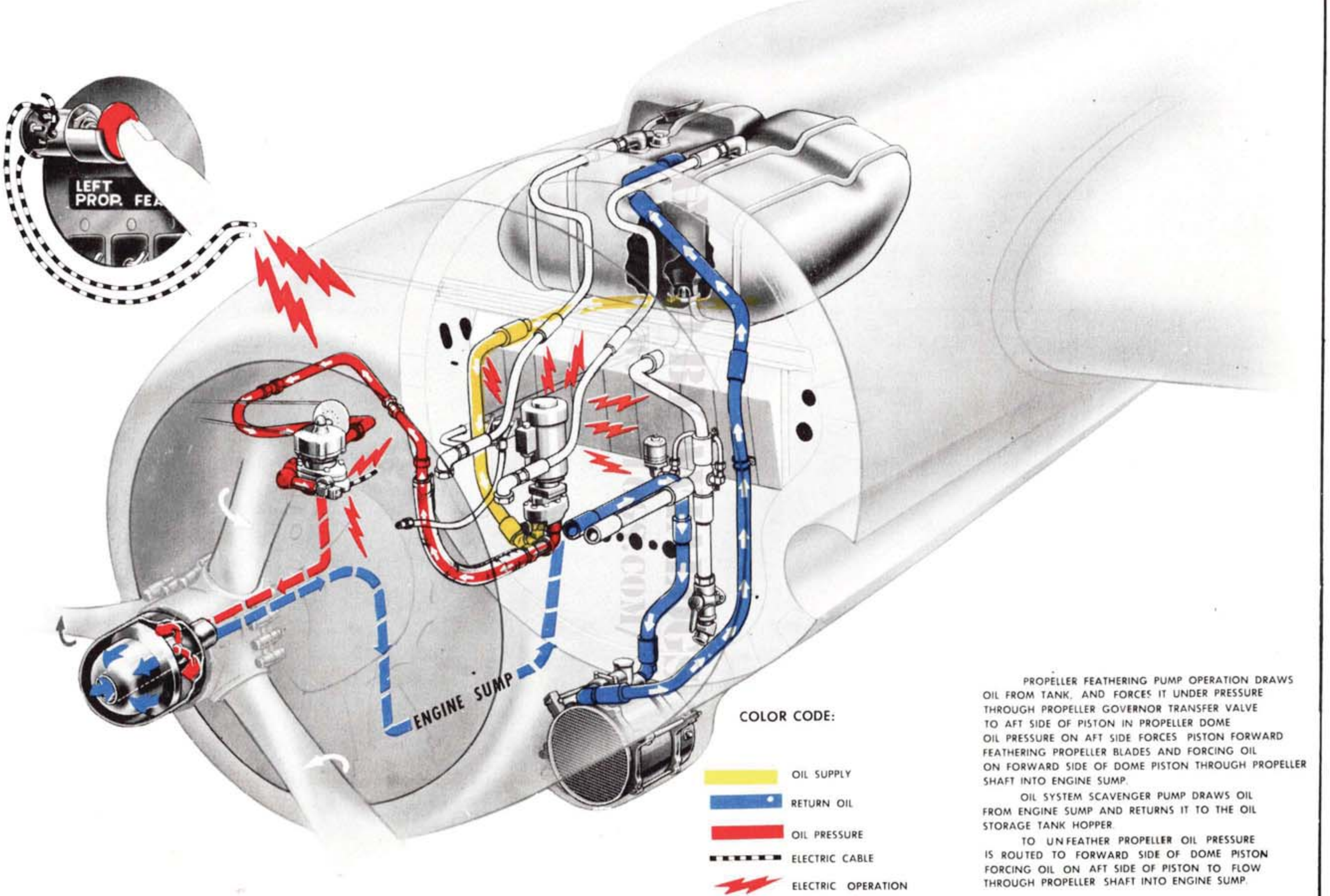


Figure 284—Oil-Pressure Transmitter Installed

1. Oil-Pressure Transmitter
2. Oil Line—Pressure Transmitter to Check Valve
3. Oil Line—Engine to Pressure Transmitter
4. Oil Line—Pressure Transmitter to Flexible Line

k. PRESSURE GAGE. *(See 3, figure 279.)*—On some airplanes a separate oil-pressure gage for each engine is installed on the instrument panel. These gages are the direct-reading type connected to an oil line. On other airplanes a dual gage is installed on the instrument panel which is of the indirect-reading type. A transmitter located on each engine is connected to the gage by lines filled with compass fluid. For more details of this gage and transmitter refer to paragraph 11.*e.*, "Instruments."

l. TEMPERATURE INDICATOR. *(See 4, figure 279.)*—The oil temperature indicators mounted on the instrument panel consist of two single indicators on some airplanes and one dual indicator on others. The temperature bulb on the right-hand side of the rear engine accessory case furnishes remote indication to the temperature indicator. Normal oil temperature is 60 to 70°C (140 to 158°F). For further details, see paragraph 14.*c.*(3) and *j.*(3), "Electrical System."


LEFT PROP. FEA
ENGINE SUMP
COLOR CODE:
OIL SUPPLY
RETURN OIL
OIL PRESSURE
ELECTRIC CABLE
ELECTRIC OPERATION

PROPELLER FEATHERING PUMP OPERATION DRAWS OIL FROM TANK, AND FORCES IT UNDER PRESSURE THROUGH PROPELLER GOVERNOR TRANSFER VALVE TO AFT SIDE OF PISTON IN PROPELLER DOME OIL PRESSURE ON AFT SIDE FORCES PISTON FORWARD FEATHERING PROPELLER BLADES AND FORCING OIL ON FORWARD SIDE OF DOME PISTON THROUGH PROPELLER SHAFT INTO ENGINE SUMP.

OIL SYSTEM SCAVENGER PUMP DRAWS OIL FROM ENGINE SUMP AND RETURNS IT TO THE OIL STORAGE TANK HOPPER.

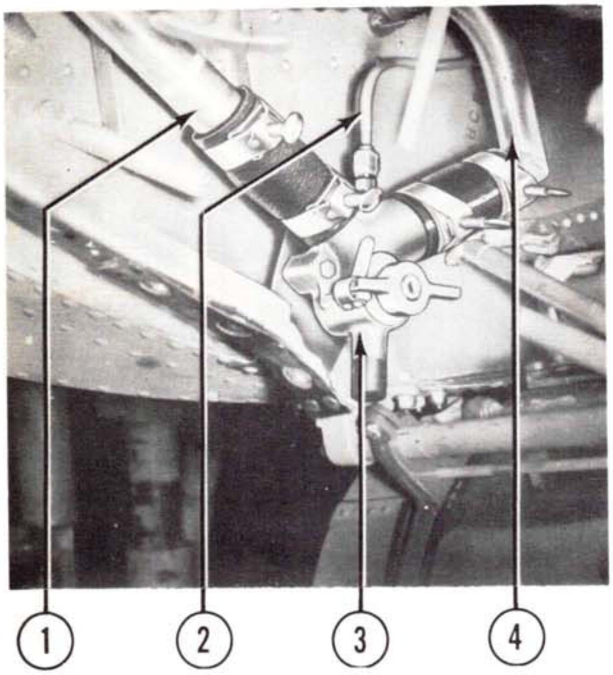
TO UNFEATHER PROPELLER OIL PRESSURE IS ROUTED TO FORWARD SIDE OF DOME PISTON FORCING OIL ON AFT SIDE OF PISTON TO FLOW THROUGH PROPELLER SHAFT INTO ENGINE SUMP.

Figure 285—Propeller Feathering Oil System

m. OIL SYSTEM TROUBLE SHOOTING.

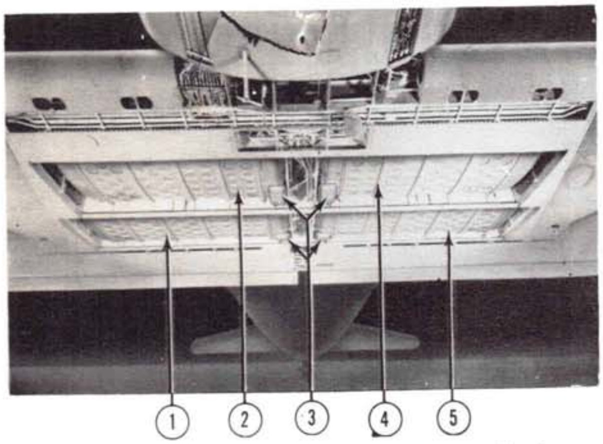
Trouble	*Probable Cause*	*Remedy*
LOW OIL PRESSURE.	High oil temperature.	See trouble shooting for high oil temperature, following.
	Excessive oil foaming. High altitude operation. Excessive hot oil. Oil supply low.	Check oil in tank. If excessive foaming is evident, drain system and fill with new oil.
	Leak, congealed oil, or air in oil-pressure gage line; leak or air in oil-pressure transmitter line.	Inspect lines and fittings for leaks. Bleed out congealed oil or air. Refill pressure transmitter lines with compass fluid.
	Leaking oil dilution solenoid valve.	Check valve for pitted seat or dirt on seat. Flush valve through inlet line. Remove plug on bottom of valve. With plug out, check for leaks. Ten drops per minute is permissible leakage.
	Faulty engine parts or operation. Pump. Strainer. Oil-pressure relief valve. Excessive engine operating clearances.	See engine section trouble shooting chart, paragraph 6., this section.
HIGH OIL TEMPERATURE.	Operating at excessive manifold pressure.	
	Insufficient oil supply.	Check oil level in tanks. If supply is exceedingly low, check lines and fittings for leaks.
	Oil cooler shutters not operating properly.	Operate controls in pilots' compartment. If shutter operation is faulty, check linkage as instructed in paragraph 9.*f.*, this section.
	Diluted or dirty oil.	Check oil at tank or at draincock. If oil is dirty, drain and replace. If oil is diluted, check oil dilution solenoid valve as instructed in trouble shooting item on leaking oil dilution solenoid valve, preceding.
	Damaged or restricted core.	Clean or replace as instructed in paragraph 9.*e.*(3)*(d).*, this section.
	Oil cooler bypass valve defective.	Improper spring tension.
LOSS OF OIL (HIGH OIL CONSUMPTION).	Oil temperature too high.	See trouble shooting item for high oil temperature, preceding.
	Oil pressure too high.	See trouble shooting item for high oil pressure following.
	Leaks in system.	Inspect lines and fittings for leaks.

Trouble	*Probable Cause*	*Remedy*
LOSS OF OIL (HIGH OIL CONSUMPTION)—Cont'd.	Oil viscosity too low.	Check oil dilution solenoid valve.
	Faulty engine parts or operation.	See engine trouble shooting information, paragraph 6.*b.*(13), this section.
	Clogged breather lines from engine blower case.	Clean out lines.
HIGH OIL PRESSURE.	Low air temperature (oil too viscous).	Warm oil supply with ground heating unit.
	Defective gage or pressure transmitter.	See instructions given in paragraph 11.*e.*(2)*(a),* this section.
	Congealed oil in clogged oil cooler.	Warm oil with ground heating unit. **Note** Do not warm oil by using torch or warm water. If cooler is clogged, clean as instructed in paragraph 9.*e.*(3)*(d),* this section.
	Improper operation of oil pressure relief valve.	Refer to engine section trouble shooting information, paragraph 6.*b.*(13), this section.
NO OIL PRESSURE.	Faulty gage or pressure transmitter.	See paragraph 11.*e.*(2)*(a),* this section.
	Damaged oil intake lines or gage lines.	Inspect lines and fittings for damage.
	Faulty oil pump.	See engine trouble shooting information, paragraph 6.*b.*(13), this section.
	Air-lock in intake line.	Prime line—preoil engine.
DELAY IN REGISTERING OIL PRESSURE.	Loose or leaking connections.	Check fittings and connections for tightness.
	Excessive viscosity (pump drawing air into oil system).	Warm oil supply with a ground heating unit.
FLUCTUATING OIL-PRESSURE GAGE.	Insufficient oil supply.	Check oil level in tanks. If supply is exceedingly low, check lines and fittings for leaks. If supply is normal check oil pump for faulty operation. (Refer to engine trouble shooting information, paragraph 6.*b.*(13), this section.)
	Air in pressure gage or pressure transmitter lines.	Bleed lines. Refill pressure transmitter lines with compass fluid.
	Oil viscosity too high.	Warm oil with ground heating unit.



1. Oil Line—Tank to "Y" Drain
2. Line—Oil Dilution Solenoid Valve to "Y" Drain Cock
3. "Y" Drain Cock
4. Propeller Feathering Oil Line

Figure 286—"Y" Drain Cock on Fire Wall



1. Right Auxiliary Tank
2. Right Main Tank
3. Water Collecting Sumps
4. Left Main Tank
5. Left Auxiliary Tank

Figure 287—Fuel Tanks Installed

10. FUEL SYSTEM

a. GENERAL.—Fuel is supplied from two main tanks and two auxiliary tanks mounted in the center wing of the airplane. (See figure 287.) The fuel quantity is measured by the liquidometer system which consists of a float assembly and a liquidometer tank unit in each tank electrically connected to the fuel gage located on the right instrument panel in the pilots' compartment. (Refer to section IV, paragraph 11.) There are two tank selector valves, operated by dial and handle controls in the pilots' compartment. Under normal conditions, the left engine draws fuel from the left tanks and the right engine draws fuel from the right tanks, but, by using the selector valves, fuel may be supplied from any tank to either engine. (See figure 288.) Lines lead from the selector valves to the two hand-operated wobble pumps. These pumps are used to raise the fuel pressure when starting the engines, or before the engine-driven pumps are in operation. The fuel flows from the wobble pumps through lines to the strainers, located in each nacelle, through the engine-driven pumps, and from there, under pressure, into the carburetors. (See figure 288.) A cross-feed line is connected on the pressure side of each engine-driven pump, and the two cross-feed valves in this line are operated by a single control in the pilot's compartment. The cross-feed system enables both engines to receive fuel from one engine-driven pump in case either pump fails. On late C-47A airplanes and all C-47B airplanes the wobble pumps are replaced by two electric booster pumps, with the fuel strainers relocated in the system just ahead of the booster pumps. (See figure 289A.) Each fuel strainer is located in the center wing near each selector valve. The fuel, therefore, flows from the selector valves, through the strainers, through the booster pumps, through the engine-driven fuel pumps into the carburetor. On airplanes equipped with electric booster pumps, there is no crossfeed system. The booster pumps will furnish ample pressure and supply for operation of the airplane in case either engine-driven pump fails. Operation of the selector valves on these airplanes remains the same. A vapor overflow line connects from the top chamber of the carburetor to the main tanks, and a fuel line from the back of each carburetor operates the fuel pressure gage in the pilot's compartment. This pressure gage normally shows from 14 to 16 pounds pressure. (See section IV, paragraph 11.) On some airplanes a pressure warning switch was installed in the fuel-pressure gage line, and when the fuel pressure dropped below 12 pounds, the pressure warning switch operated a warning light in the pilots' compartment. (Refer to section IV, paragraph 14.*b.* (11).) A restricted fitting on the fuel pressure gage line connects to an oil-dilution solenoid which releases fuel into the engine oil system and the propeller feathering oil. Another solenoid valve in the fuel pressure gage line releases fuel into the eight upper cylinders of the engines for priming. The engine primer solenoid is mounted either in the nacelle, near the fuel strainer, or on the fire wall next to the oil-dilution solenoid. On some airplanes, a Parker hand primer, located in each nacelle, is used in place of the primer solenoid valve. Vent lines from each tank vent overboard, and a vapor line connects each main tank with its corresponding auxiliary tank. A system drawing showing all fuel system lines and fittings will be found in section VIII.

Note

To prevent the clogging of fuel system components, the sloshing of all C-47 aircraft fuel tanks will be discontinued.

b. TANKS.

(1) DESCRIPTION.—The tanks are constructed by welding together an upper and lower shell of 3S half-hard aluminum sheets. Each tank is equipped with a water-collecting sump (3, figure 287) and a drain cock (figure 290) located on the bottom of the tank. On very late C-47B airplanes a Kohler K-1700 B type drain cock is used. This Kohler drain cock does not reauire the use of a safety wire. A cartridge containing potassium chromate crystals is placed

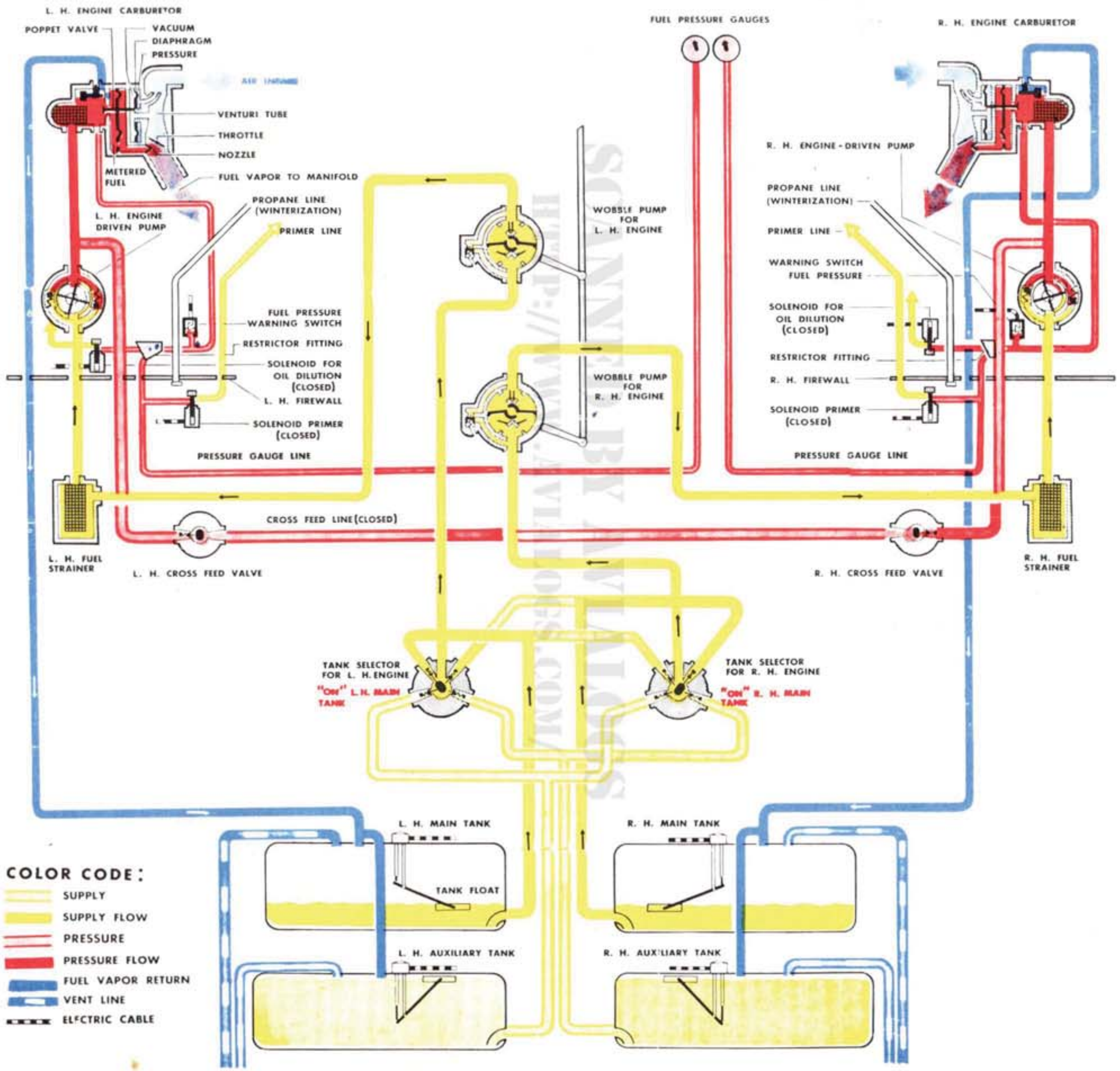

L. H. ENGINE CARBURETOR
POPPET VALVE
VACUUM
DIAPHRAGM
PRESSURE
AIR INTAKE
VENTURI TUBE
THROTTLE
NOZZLE
METERED FUEL
FUEL VAPOR TO MANIFOLD
L. H. ENGINE DRIVEN PUMP
PROPANE LINE (WINTERIZATION)
PRIMER LINE
FUEL PRESSURE WARNING SWITCH
RESTRICTOR FITTING
SOLENOID FOR OIL DILUTION (CLOSED)
L. H. FIREWALL
SOLENOID PRIMER (CLOSED)
PRESSURE GAUGE LINE
L. H. FUEL STRAINER
L. H. CROSS FEED VALVE
CROSS FEED LINE (CLOSED)
FUEL PRESSURE GAUGES
WOBBLE PUMP FOR L. H. ENGINE
WOBBLE PUMP FOR R. H. ENGINE
R. H. ENGINE CARBURETOR
R. H. ENGINE - DRIVEN PUMP
PROPANE LINE (WINTERIZATION)
PRIMER LINE
WARNING SWITCH FUEL PRESSURE
SOLENOID FOR OIL DILUTION (CLOSED)
RESTRICTOR FITTING
R. H. FIREWALL
SOLENOID PRIMER (CLOSED)
PRESSURE GAUGE LINE
R. H. FUEL STRAINER
R. H. CROSS FEED VALVE
TANK SELECTOR FOR L. H. ENGINE
"ON" L. H. MAIN TANK
TANK SELECTOR FOR R. H. ENGINE
"ON" R. H. MAIN TANK
L. H. MAIN TANK
TANK FLOAT
R. H. MAIN TANK
L. H. AUXILIARY TANK
R. H. AUXILIARY TANK
COLOR CODE:
SUPPLY
SUPPLY FLOW
PRESSURE
PRESSURE FLOW
FUEL VAPOR RETURN
VENT LINE
ELECTRIC CABLE

Figure 288—Fuel System Schematic Diagram

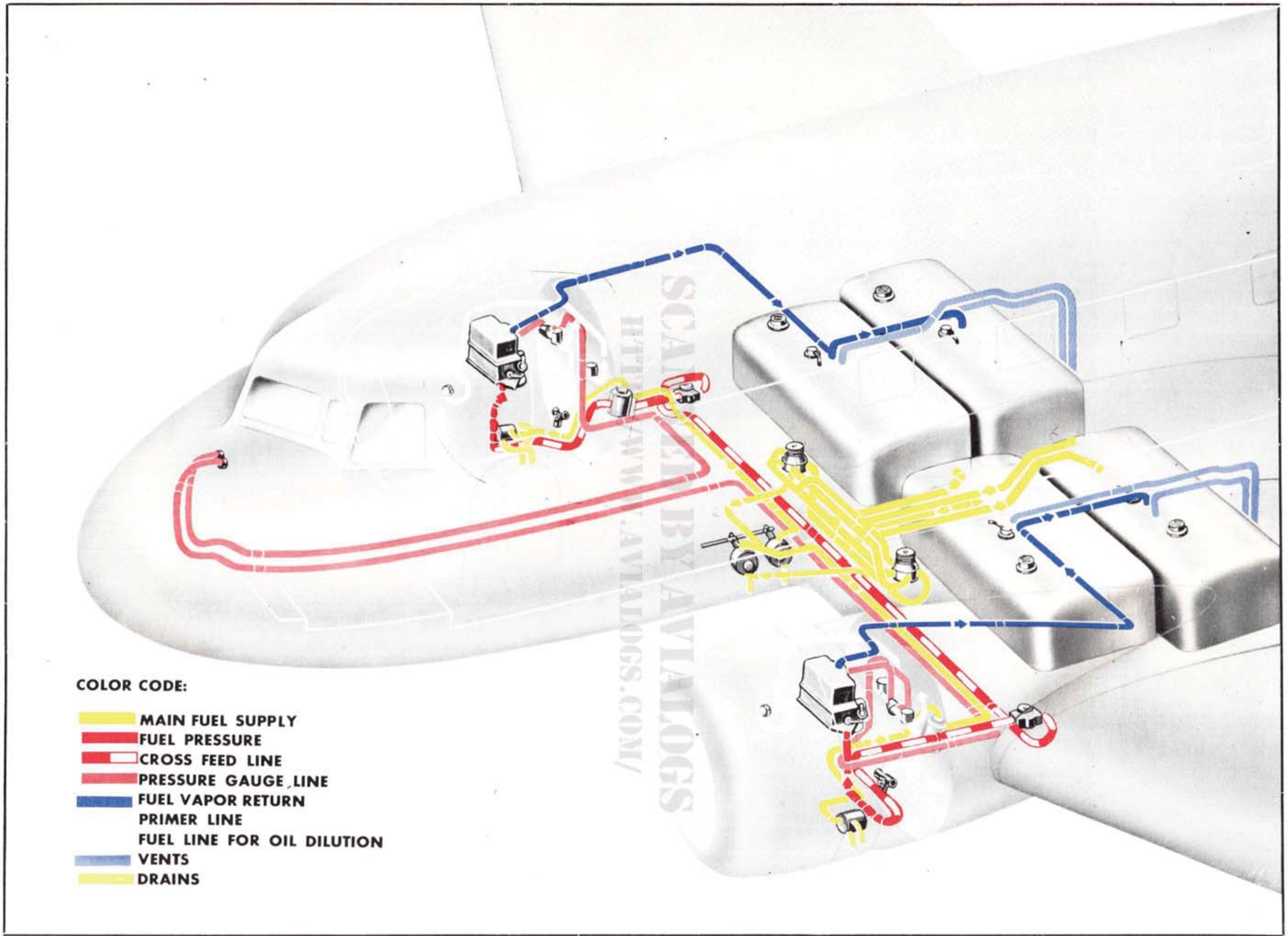
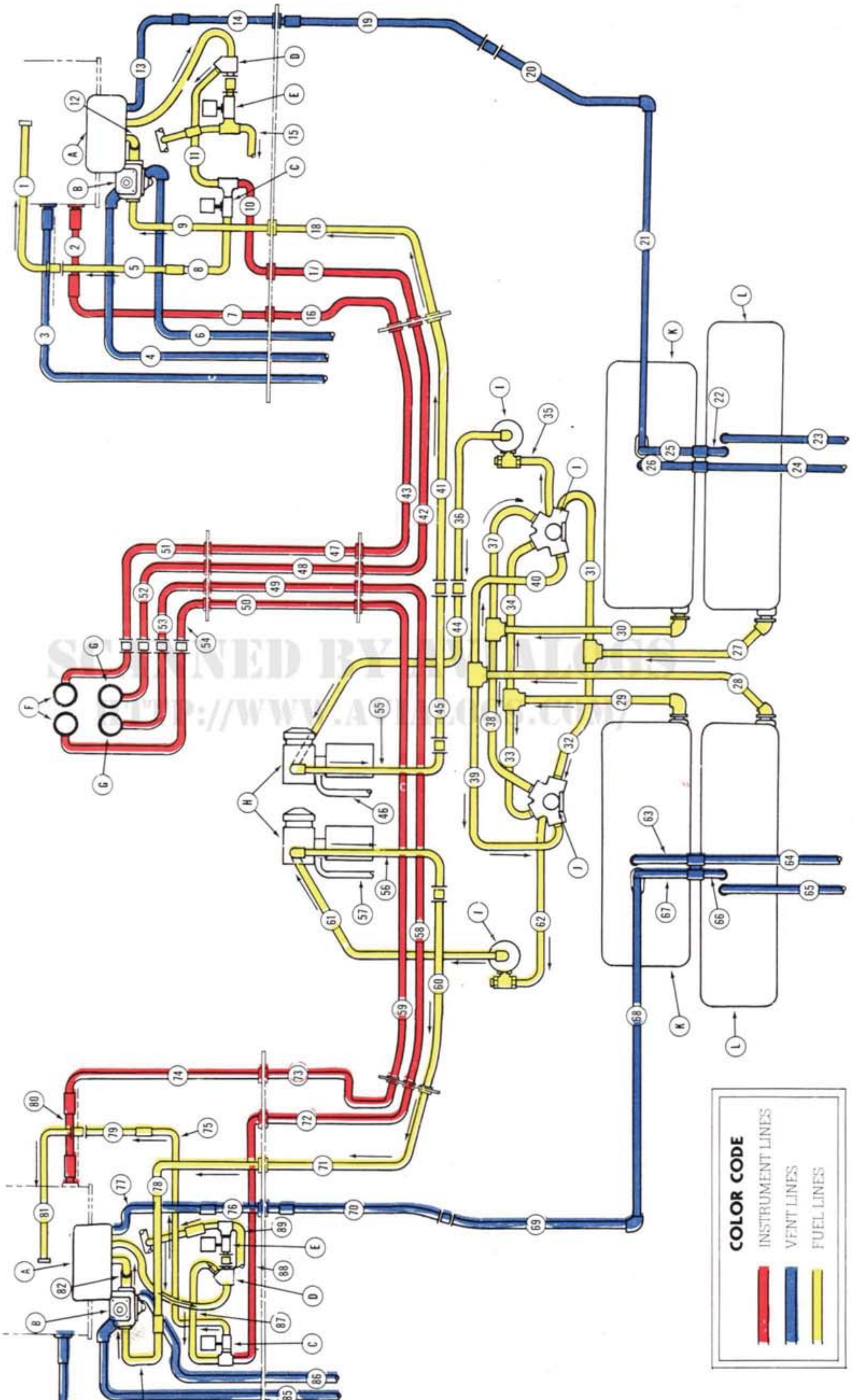

COLOR CODE:
MAIN FUEL SUPPLY
FUEL PRESSURE
CROSS FEED LINE
PRESSURE GAUGE LINE
FUEL VAPOR RETURN
PRIMER LINE
FUEL LINE FOR OIL DILUTION
VENTS
DRAINS

Figure 289—C-47A Fuel System Flow Diagram



COLOR CODE
INSTRUMENT LINES
VENT LINES
FUEL LINES
A
B
C
D
E
F
G
H
I
J
K
L
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89

Figure 289A—Late C-47A and C-47B Fuel Flow Chart (Also See Figure 628 A)

KEY TO FIGURE 289A

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
A	PD12F5	Bendix Stromberg Carb.	2
B	AN4101	Fuel Pump	2
C	AAF37D-6210	Solenoid Valve	2
D	AN4077-1	Restricted Fittings	2
E	AAF37D-6210	Solenoid Valve	2
F	AN5770-2	Manifold Pressure Gage	1
G	AN5772-1	Fuel Pressure Gage	1
H	AN4101	Fuel Pump	2
	AN4059-1	Gasket	2
	A4949	Electric Motor	2
I	23410	Aero Supply Fuel Strainer	2
J	5205618 LH	Selector Valve Assem.	1
	5205618-1 RH	Selector Valve Assem.	1
K	5110508 LH	Main Fuel Tank	1
	5110508-1 RH	Main Fuel Tank	1
L	5110509 LH	Aux. Fuel Tank	1
	5110509-1 RH	Aux. Fuel Tank	1

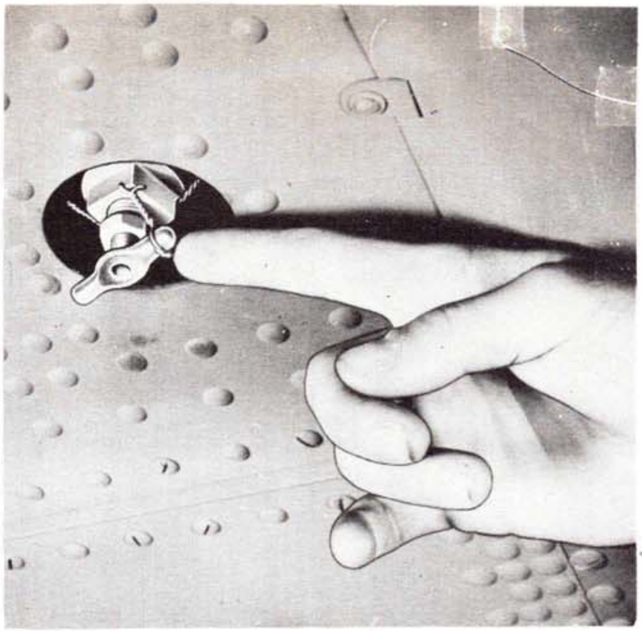
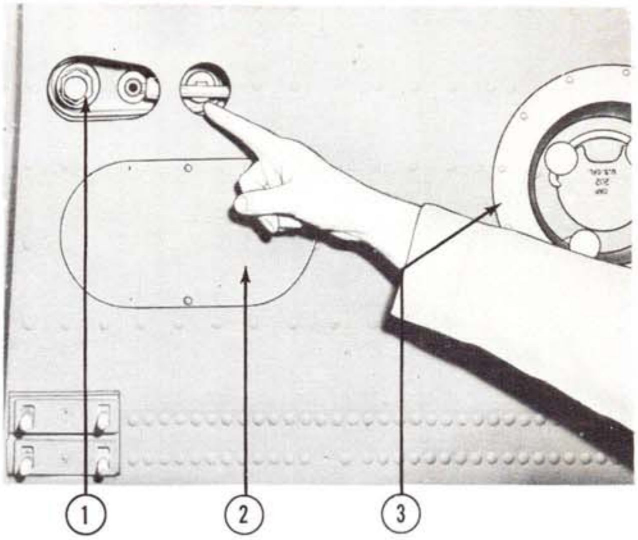


Figure 290—Fuel Tank Drain Cock



1. Carburetor Return Line Connection
2. Access Hole
3. Filter Neck and Returning Ring

Figure 291—Fuel Tank Fittings on Top of Center Wing

in each tank sump to prevent corrosion. This cartridge should be cleaned and the potassium chromate crystals replaced with new crystals No. 4 to No. 12 mesh size every 300 hours or every six months, whichever comes first. An electric liquidometer unit in the top of each tank connects to an indicator on the right-hand instrument panel in the pilots' compartment. (See section IV, paragraph 14.*c.*(7).) The two main tanks, each with a capacity of 202 U.S. (168 Imperial) gallons, are mounted in the center wing of the airplane between the front and center wing spars on each side of the airplane center line (2, 4, figure 287). The auxiliary tanks, with a capacity of 200 U. S. (167 Imperial) gallons each, are mounted directly aft of the main tanks between the center and rear spars (1 and 5, figure 287). The tanks are supported by a padded cradle assembly (figure 287) which is made fast to the center wing by 24 ST aluminum straps. To prevent leakage of fuel past the rubber seal on main and auxiliary fuel tank filler necks, clips are installed on the filler neck assemblies.

(2) REMOVAL.

(*a*) TO REMOVE THE MAIN FUEL TANK, RIGHT OR LEFT.

1. Remove the top plate (3, figure 291) from around the filler neck by unscrewing the screws. Allow the rubber gasket to remain with the tank.

2. Working through the inspection holes near the filler neck (2, figure 291), disconnect the vent lines, the carburetor return line (1, figure 291), and the liquidometer tank unit wiring.

3. Remove the bottom plating from the wing center section under the tank by taking off the para-pack attach brackets, unscrewing the line of screws on the spars at the front and rear ends of the plate, and unfastening the bolts in the flanges at the sides of the plate.

Note

Two men will be required. It will be found helpful if, when removing the screws from the fore and aft edges of the cover plate, two screws are left in near the middle of the plate on each edge. Then, with one man supporting the plate, these screws may be removed last.

4. Disconnect the electrical bonding braids from the tank bay. Do not disconnect from the tank and do not fasten the disconnecting bonding braids together, as there is danger of damaging the soldered tank connection or of pulling the bonding braids loose.

5. Remove the cover from the tunnel between the left and right tank by unscrewing the screws at the fore and aft end of the tunnel cover. This exposes the main fuel lines.

6. Disconnect the main fuel line at the tank fitting and at the tee on the line leading to the selector valves. Remove this section of fuel line.

7. Remove the fuel line fitting from the tank.

Note

On some airplanes a flexible conduit was used for the fuel quantity gage wiring. Where this is found to be the case, reach inside the front part of the tank compartment and unscrew the collar on the flexible conduit and pull the conduit and wires out.

8. Unscrew the turnbuckles in the tank support straps and drop the tank downward. Two men will be required.

9. When cleaning the fuel tanks with paint remover or any other soluble, make certain the tanks are properly vented at all times to prevent expansion. If tanks have been exposed to sun or any high temperatures immediately prior to cleaning with paint remover the paint remover will vaporize, causing the tank to expand and possibly burst, if not vented.

(*b*) TO REMOVE THE AUXILIARY FUEL TANK, RIGHT OR LEFT.—The auxiliary fuel tank is removed by using the same procedure as outlined for removing the main fuel tank.

(3) (Deleted)

PAGE 232 DELETED.

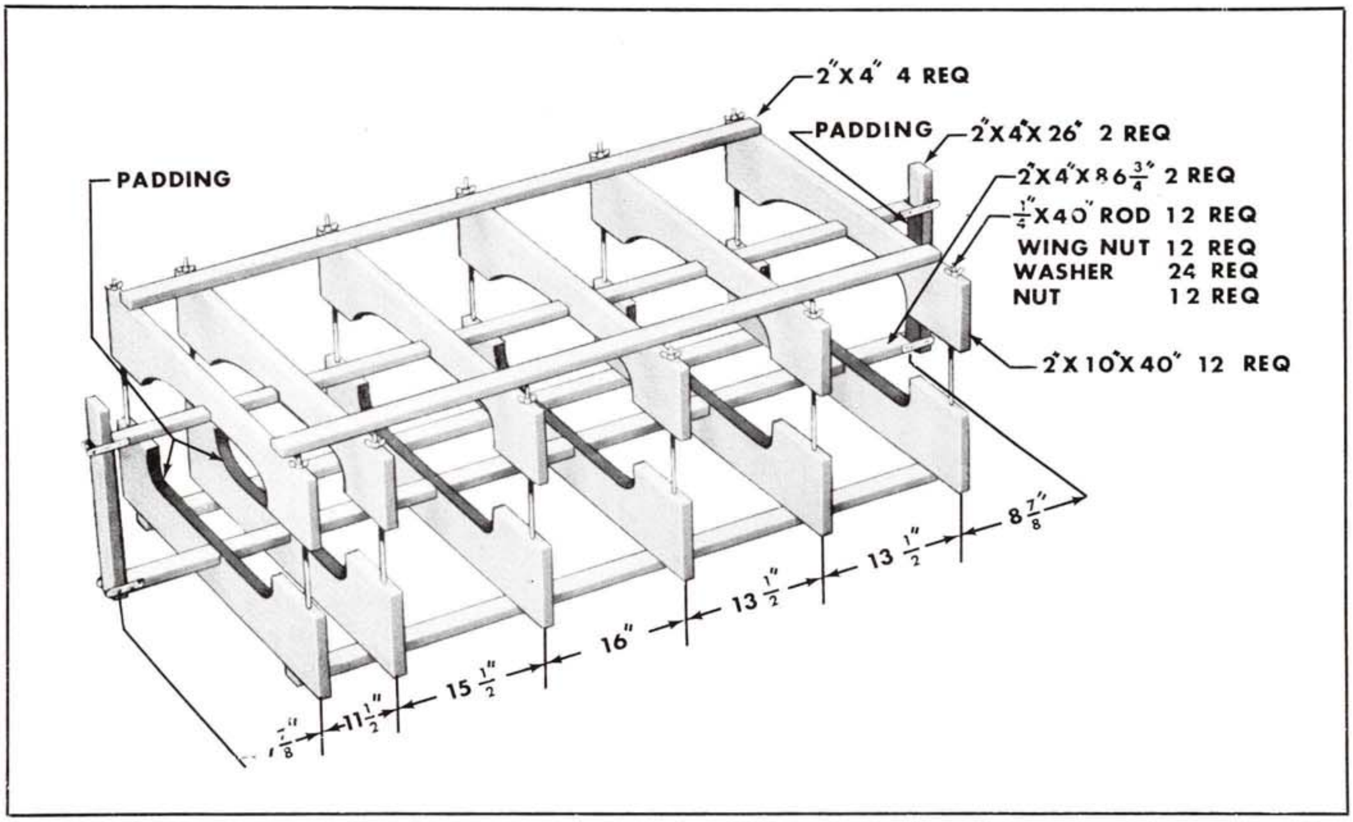


Figure 292—Jig for Pressure Testing of Metallic Fuel Tanks

(4) INSTALLATION.

(a) Fuel tanks may be reinstalled by reversing the removal procedure but the following suggestions should be noted:

1. Check all seams in the tank bay and if any of the black sealing compound is cracked or loose, reseal with Dupont 5115 Fairprene caulking compound, or equal.

2. When installing the main tank a little soapstone on the strap pads will make the tank slide in place more easily.

3. Put the inboard end of the main tank in place first. Have one man on top of the wing to connect the carburetor return line (1, figure 291) to the tank fitting. Raise the entire tank into the tank bay; then, drop the inboard end of the tank slightly and push the carburetor return line down to meet the fitting and connect before the tank is in place.

Note

> It is important that this connection be made in the preceding manner. It will be difficult to make the connection after the tank is completely in place.

4. There is a small pitot-static line in the aft end of the left auxiliary bay. Be careful not to bend or damage this line when installing the left auxiliary tank.

c. FUEL TANK SELECTOR VALVES.

(1) DESCRIPTION. – The fuel tank selector valves (figure 293) are four-way valves mounted on the forward face of the front spar on each side of the airplane center line. The valves are operated through cables and pulleys by two handle and dial controls (figure 294) on the engine control pedestal in the pilots' compartment. Fuel may be supplied from any tank to either engine by use of these valves.

(2) REMOVAL.

(a) A panel with two access holes marked "TANK SELECTOR VALVE" is located near the front of the center wing. Remove this entire panel.

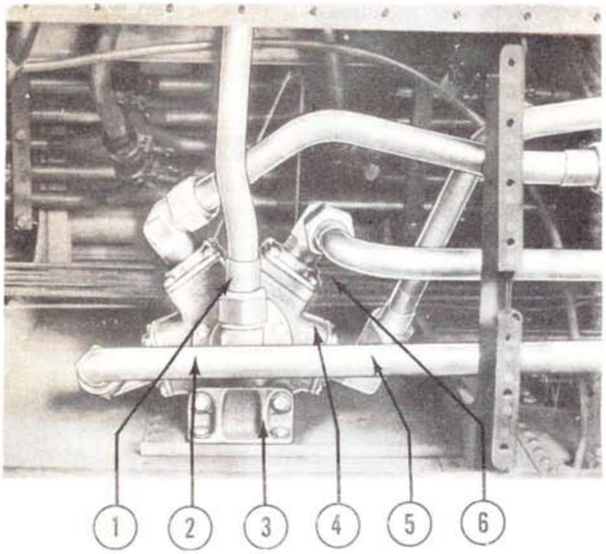


Figure 293—Tank Selector Valve Installed

1. Left Main Tank Port
2. Left Auxiliary Tank Port
3. Support Bracket
4. Plate
5. Right Auxiliary Tank Port
6. Right Main Tank Port

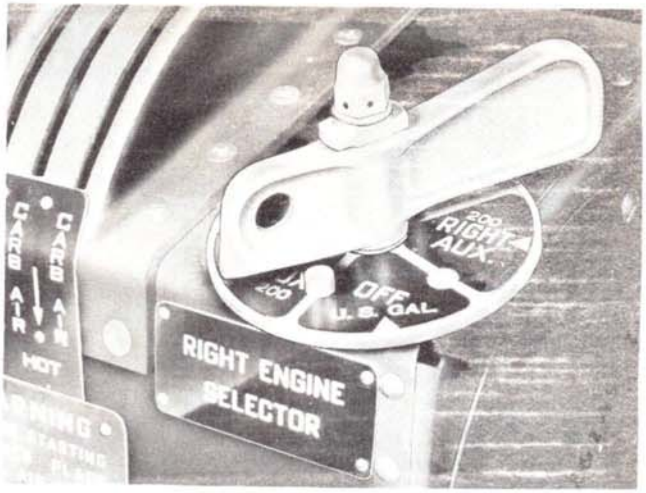


Figure 294—Selector Valve Control

(b) Remove the long narrow panel forward of this which is marked "FUEL AND INSTRUMENT LINES."

(c) Remove the entire panel which has the two access holes marked "DE-ICER UNIT" and "WOBBLE PUMPS."

(d) Locate the selector valve control cables (figure 295) by following them forward from the drum (12, figure 295) on the selector valve. Cut the safety wire and disconnect the cables at the turnbuckles (15, figure 295) near the front of the forward opening.

(e) Remove the pulleys from the two brackets through which the cables pass. (See figure 295.)

(f) Disconnect all the lines from the selector valve. (See figure 293.)

(g) Take the selector valve off the front spar by removing the five bolts and one nut in the support bracket.

Note

> Remove the five bolts first; then, letting the weight of the selector valve bind slightly against the sixth bolt, carefully remove the nut. As the head of this bolt is inside the tank bay there is no other way to keep the bolt from turning.

(h) To remove the selector valve only, disconnect the lines and unscrew the nuts from the two long bolts holding the valve to the small attach bracket (3, figure 293) at the bottom of the valve. Take out the two bolts holding the small attach bracket (3, figure 293) and the valve will be free to drop down. This is for removing the valve only, and will not give access to the control drum or cables.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) If the selector valve is leaking, look for the worn gaskets around the valve ports (1, 2, 5, and 6, figure 293) and around the cover plate (4, figure 293). If parts are available, gaskets may be replaced. Otherwise, the entire unit should be replaced and unsatisfactory unit forwarded for overhaul.

(b) Check the control cables for wear; replace if necessary.

(c) Examine pulleys, pulley brackets, and selector valve support bracket for damage; replace if necessary.

(4) ASSEMBLY AND INSTALLATION.—The tank selector valve may be reinstalled by reversing the removal procedure, but the following precautions should be noted:

(a) Put the selector valve bracket in place and screw the nut on the bolt that is already in place. This is the bolt mentioned in the note under paragraph 10.*c.*(2)*(g)*. Let the weight of the valve bind the bolt to keep it from turning. When this nut is secure, replace the five bolts by screwing into place.

(b) When replacing the pulleys in the forward bracket, make sure that the nut is on top, with the head of the bolt down. This is necessary to allow clearance for other control cables.

(c) Remember that the top cable on the selector valve control drum goes over the top pulley in the two pulley brackets and the bottom cable goes over the bottom pulleys. (See figure 295.)

(d) The bottom cable always goes through the left fair-lead.

(e) When the cables have been connected and the control in the pilots' compartment (figure 294) is adjusted correctly, safety the cable turnbuckles.

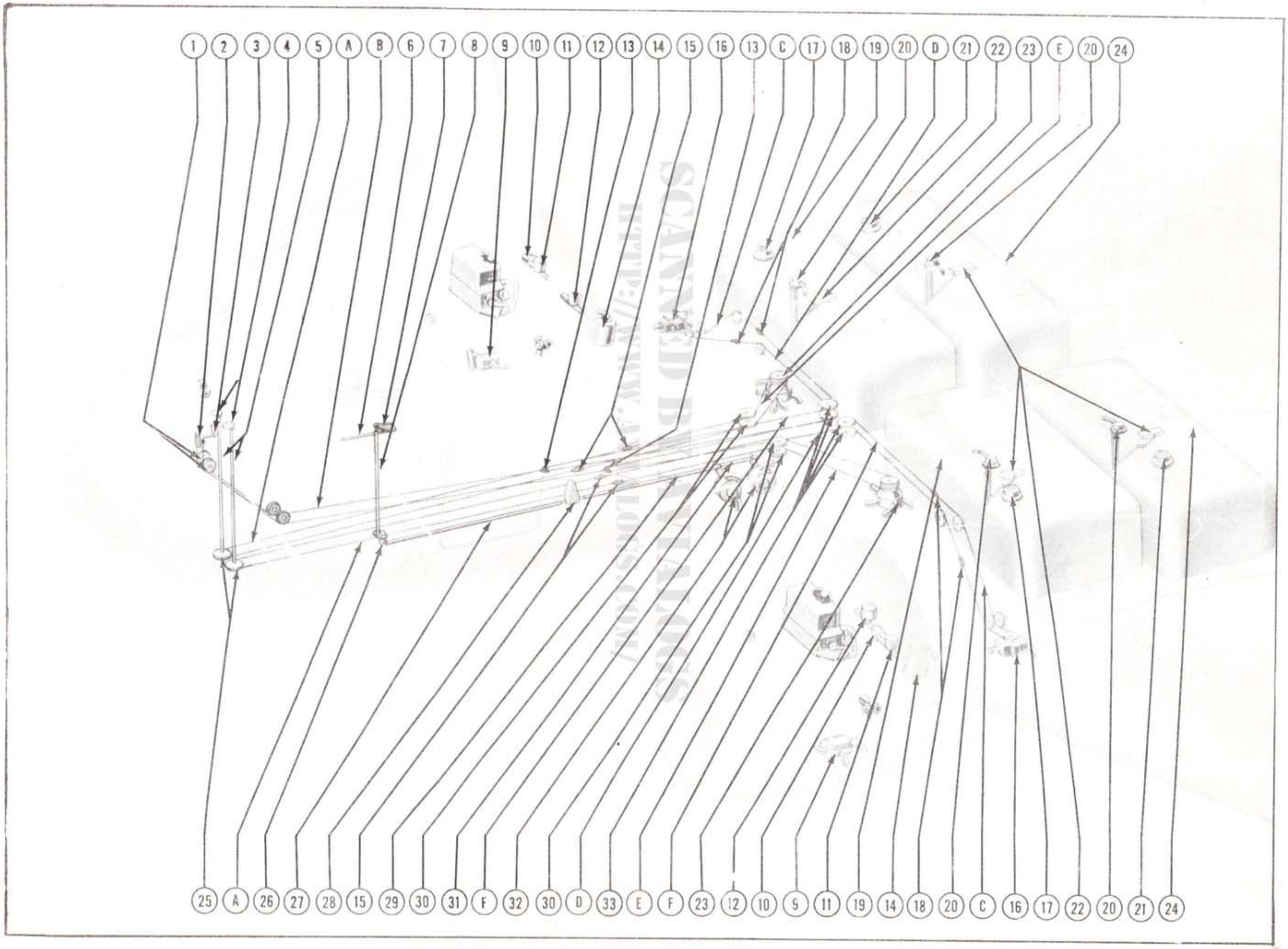

1
2
3
4
5
A
B
6
7
8
9
10
11
12
13
14
15
16
13
C
17
18
19
20
D
21
22
23
E
20
24
25
A
26
27
28
15
29
30
31
F
32
30
D
33
E
F
23
12
10
9
11
19
14
18
20
C
16
17
22
20
21
24

Figure 295—Fuel System Parts and Controls

KEY TO FIGURE 295

NOTE

All pulleys are AN210-1A unless otherwise noted.

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	AN210-2A	Cross-Feed Valve Control Cable Pulleys	2
2	1116247	Cross-Feed Control Operating Pulley	1
3	2116155	Cross-Feed Valve Indicator Assembly	1
4	2116171	Selector Valve Indicator Assembly	2
5	2116171-1	Selector Valve Drive Rod, Dial to Control Drum	2
	1004348	Adapter	2
	124604-10-8	Taper Pin	2
	1119215	Drum Shaft	2
	AN340-6	Nut	2
6	2118774	Wobble Pump Handle Assembly	1
7	2118778	Mounting Bracket, Actuating Arm at Wobble Pump Handle	1
	Attached by:		
	AN3-4A and	Bolt	4
	AF365-1032	Nut	4
	2118780	Wobble Pump Actuating Arm at Handle	1
	AF386-2-10A	Taper Pin	1
	AF365-D-1032	Nut	1
8	2118784	Wobble Pump Actuating Link, Handle to Bell Crank	1
	AN3-12A	Bolt	2
	AF365-1032	Nut	2
	1045702	End	2
	AN316-6R	Nut	2
9	AF Type G-9	Engine-Driven Fuel Pump	2
10	AF37A3528	Restrictor Fitting	2
11	AF37D6210	Type M-441-M2 Oil Dilution Solenoid Valve	2
	Each attached by:		
	1118130	"U" Bolt	1
	AC365-1032	Nut	2
12	AF37D6210	Type M-441-M2 Engine Primer Solenoid Valve	2
	Attached by:		
	1118130	"U" Bolt	2
	AF365-1032	Nut	4
	or		
	401-1A	Parker Hand Primer (in Nacelle)	2
13	1116326	Bridle	2
14	Aero Supply No. 23410	Fuel Strainer	2
	Attached by:		
	AN4-24A	Bolt	4
15	AN155-16S	Barrel	4
16	5119377	Cross-feed Valve Assembly (LH)	1
	5119377-1	Cross-feed Valve Assembly (RH)	1
	Consists of:		
	94083 Type PD-3	Valve Assembly (LH)	1
	94084 Type PD-3	Valve Assembly (RH)	1
	1118141	Pulley	2
	AN320-6	Nut	2
	1019188-3	Shaft	2
	4118686	Base	2
	117425-6D-003	Spacer	4
	138695	Plate	2
	138687-1	Driver	2
	2118143	Bracket	2
	AN3-31A	Bolt	4
	AF365-1032	Nut	8
	AN3-7A	Bolt	4

KEY TO FIGURE 295—Continued

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
	Attached by:		
	AN3-6A	Bolt	16
	AF365-1032	Nut	16
17	2075832-R-202	Cap Assembly, Main Fuel Tank	2
18	AN155-16L	Turnbuckle, Cross-Feed Control Cable	4
19	5110508	Left Main Fuel Tank	1
	5110508-1	Right Main Fuel Tank	1
20	Type EA-15	Liquidometer Tank Unit	4
21	2075832-R-200	Cap Assembly Auxiliary Fuel Tank	2
	(Items 17 and 21 Consist of):		
	S4135240	Seal-Fuel Tank Filler Neck	4
	S127057-84	Clip	4
	AN515-8-8	Screw	4
	AF365-832	Nut	4
22	4113228-5	Float Assembly	4
23	5119300	Fuel Tank Selector Valve Assembly (LH)	1
	5119300-1	Fuel Tank Selector Valve Assembly (RH)	1
	Each consists of:		
	93870	Aero Selector Valve	1
	AN3-27A	Bolt	2
	AF365-1032	Nut	2
	2118140	Control Drum	1
	AN-320-6	Nut	1
	1118138	Shaft Assembly	1
	138695	Plate	1
	138687-1	Driver	1
	4115931	Base Assembly	1
	2118142	Bracket	1
	Attached by:		
	AN3-5A	Bolt	6
	AF366-F1032	Nut Plate	6
24	5110509-1	Left Auxiliary Fuel Tank	1
	5110509-1	Right Auxiliary Fuel Tank	1
25	2119150-8 LH	Selector Valve Control Drum Assembly	1
	2119150-6 RH	Selector Valve Control Drum Assembly	1
	Attached by:		
	AN3-5A	Bolt	8
	AC365-1032	Nut	8
26	2118782	Wobble Pump Actuating Arm Support Bracket	1
	AN3-5A	Bolt	5
	AF365-1032	Nut	5
	2118779	Arm	1
	AF386-2-9A	Taper Pin	2
	AF365D1032	Nut	2
	1118770	Shaft	1
	K8-A	Fafnir Bearing	2
	2118781	Arm	1
27	2117290	Rod	1
	1045702	End	2
	AN316-6R	Nut	2
	AN3-12A	Bolt	2
	AF365-1032	Nut	2
28	2118785	Arm	1
	AN24-68A	Bolt	1
	AF365-428	Nut	1

KEY TO FIGURE 295—Continued

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
	1118769	Bracket	1
	AN3-5A	Bolt	2
	AF365-1032	Nut	2
29	2117289	Rod	1
	1045702	End	1
	AN316-6R	Nut	1
	AN3-12A	Bolt	1
	AF265-1032	Nut	1
	RE4F5	Fafnir Bearing	1
	AN316-5R	Nut	1
30	AN210-2A	Pulley Selector Valve Control Cable	4
31	1117494	Link	1
	RE4F5	Fafnir Bearing	2
	AN316-5R	Nut	2
	AN4-17A	Bolt	1
	AF365-428	Nut	2
	AN4-12A	Bolt	1
32	4139853	Romec RD-4370 Hand-Operated Wobble Pump	2
	Attached by:		
	AN4-27A	Bolt	6
	AF365-428	Nut	6
33	AN210-2A	Pulley, Cross-Feed Control Cable (See Douglas Drawing 5110584)	4

(5) ADJUSTING THE SELECTOR VALVE INDICATOR.—When the selector valve is installed, locate the small notch of the yoke adjacent to the reference mark on the top of the control shaft of the valve. This notch will be adjacent to the valve port that is open.

Move the selector valve indicator in the pilots' compartment to correspond with the open line. That is, if the notch shows that the right auxiliary tank port (5, figure 293), is open, set the indicator (figure 294) to "RIGHT AUXILIARY." Connect the cables and then double check to see that the indicator still reads "RIGHT AUXILIARY." If the indicator is slightly off center, adjust to center by adjusting the cable turnbuckles. (See 15, figure 295.) In determining which line is open, visualize the selector valve as being the same as the indicator dial in the pilots' compartment. That is, starting on the left side of the selector valve, facing forward and reading clockwise, the lines will be "LEFT AUXILIARY," "LEFT MAIN," "RIGHT MAIN," and "RIGHT AUXILIARY." (See 1, 2, 5, and 6, figure 293.)

CAUTION

Double check to make sure the indicator and the selector valve agree. Do not force the indicator. Make adjustments by using the cable turnbuckles.

d. WOBBLE PUMPS.

(1) DESCRIPTION.—The two wobble pumps are located in the nose section forward of the center wing and are mounted end to end (figure 296) to the left of the airplane center line (32, figure 295). The arms of the two pumps are connected by a link assembly. (See 1, figure 296.) This link assembly is attached to two rods which in turn connect with a bell crank on the red wobble pump handle (figure 297) which is located near the pilot's seat. When the wobble-pump handle in the pilots' compartment is moved up and down, it exerts a push-pull force on the rods connected to the two pumps and causes the pumps to operate together. The Romec-type hand pumps consist mainly of a vane and six gate valves, two inlet and four outlet. (See figure 298.) The fuel is drawn through the inlet gates (5, figure 298) and then forced by the vane (3, figure 298) under pressure through the outlet gates (6, figure 298). The pump is capable of producing up to 26 psi pressure. A bypass valve (2, figure 298) allows fuel to flow around the pump when the engine-driven pumps are operating and the wobble pump is inoperative.

(2) REMOVAL AND DISASSEMBLY.

(a) Partial access for inspection is gained by opening the door marked "WOBBLE PUMPS," but if removal of the pumps is necessary the panel on which this door is located must be removed. This panel is located underneath the airplane at the forward junction of the fuselage and the center wing.

(b) Disconnect and remove the link assembly (1, figure 296) that joins the two arms on the pump.

(c) Disconnect the inlet and outlet lines.

(d) Take out the three bolts holding each pump to the support bracket.

(e) Remove the pump.

(f) Disassemble the pump by cutting the safety

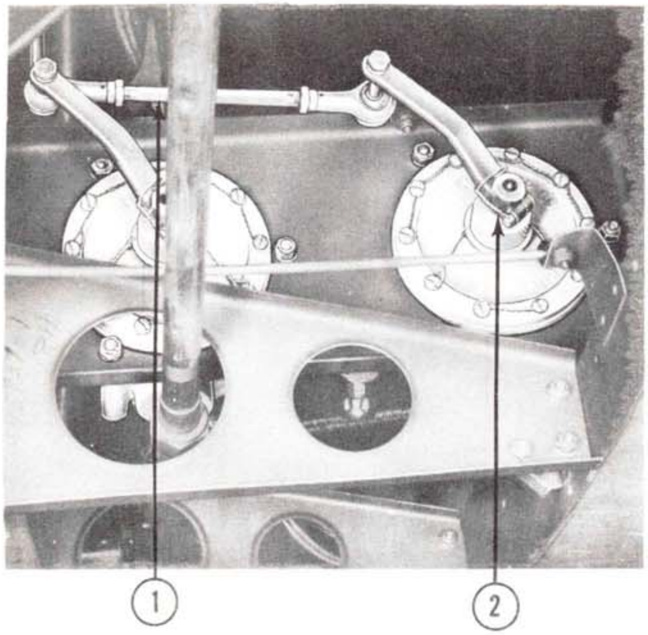


Figure 296—Wobble Pumps (Installed on Some Airplanes)

1. Link Assembly
2. Packing Nut

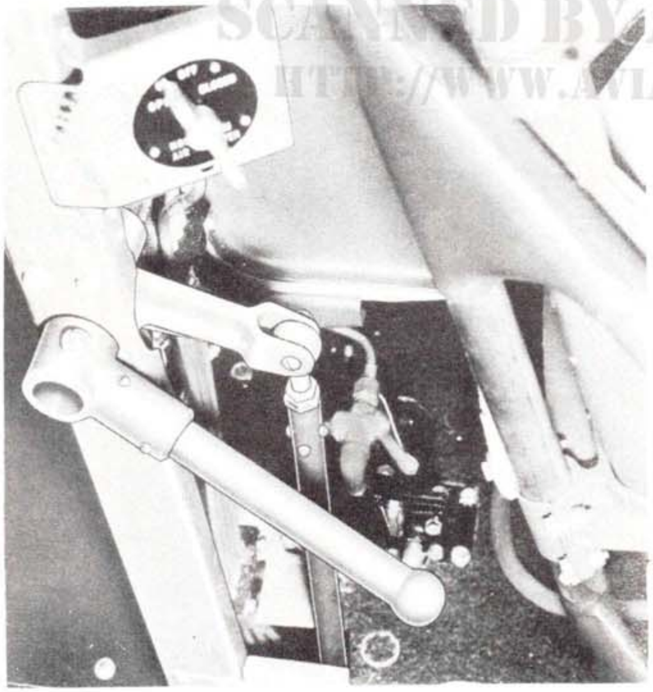


Figure 297—Wobble Pump Control (Installed on Some Airplanes)

wires and removing the screws in the plate on the arm side of the pump. (See figure 296.)

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) Clean the pump with gasoline; remove any sediment or foreign particles.

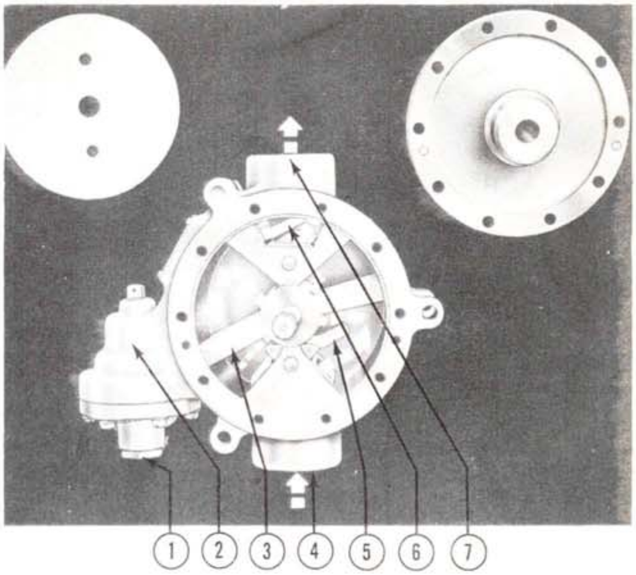


Figure 298—Wobble Pump Disassembled (Installed on Some Airplanes)

1. Pressure Adjusting Screw
2. Bypass Valve Housing
3. Vane
4. Inlet Port
5. Inlet Gate Valve
6. Outlet Gate Valve
7. Outlet Port

(b) If the vane is badly worn or any of the gates are inoperative, replace the pump.

(c) If the pump is leaking around the packing nut (2, figure 296), tighten the nut, or repack.

CAUTION

> Do not try to tighten the packing nut too tight. Repack, or replace the pump. If the leakage around the shaft is slight, then a quarter or half turn on the packing nut is indicated. Continued tightening of the packing nut is not a cure for leakage, and is apt to damage the threads and make the pump useless.

(4) ASSEMBLY AND INSTALLATION.—Assemble and install the wobble pumps by reversing the removal procedure.

(5) TEST AFTER INSTALLATION.

(a) Check the stroke of the pumps by checking the movement of the red handle near the pilot's seat (figure 297). The bracket on the bottom of the handle should touch the stops in the frame at both the top and bottom of the stroke.

(b) If a full stroke is not being obtained, adjust the first rod (figure 297), below the red wobble pump handle in the pilots' compartment, by loosening the nut between the rod and the bearing rod end and turning the rod. Turning the rod clockwise shortens the stroke; turning the rod counterclockwise lengthens the stroke.

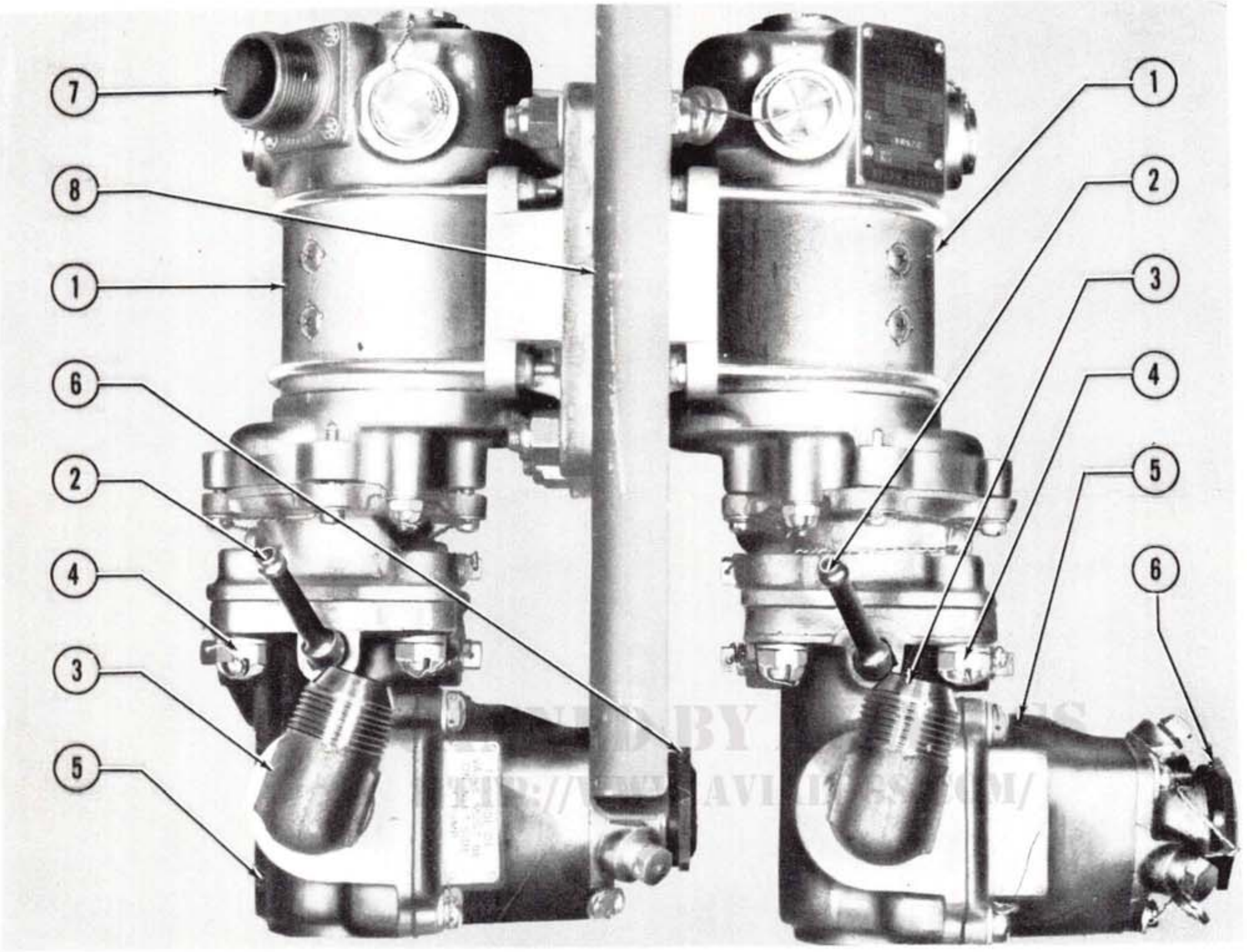


Figure 298A—Electric Booster Pumps

1. Electric Motor
2. Vent Connection
3. Inlet Port
4. Large Castle Nut (4 on each side)
5. AN4101 Fuel Pump
6. Lock Nut Cover
7. Electrical Connection
8. Bracket

(c) When operating properly, the pump should test 26 psi pressure. Pressure may be adjusted by turning the screw on the bottom of the bypass and relief valve housing. (See 1, figure 298.) Turning the screw clockwise increases the pressures.

(6) MAJOR OVERHAUL.—Overhaul of hand-operated fuel pump should be undertaken only at a regular repair depot where complete facilities for repair and testing are available.

da. ELECTRIC BOOSTER PUMPS. *(See figure 298a.)*

(1) DESCRIPTION.—On late C-47A and all C-47B airplanes two electrically driven booster pumps replace the wobble pumps. They are located at the junction of the nose section and the center wing, to the left of the airplane center line. Partial access for inspection is gained by opening the door marked "Booster Pump," but if removal of the pump is necessary, the panel on which this door is located must be removed. This panel is located underneath the airplane, at the forward junction of the fuselage and the center wing. Each pump assembly consists of an electric motor to which is bolted a type G-9 (AN4101) rotary vane-type fuel pump. This pump is identical with the engine-driven fuel pump. Each pump is controlled by a switch located on the right-hand electrical panel of the pilots' compartment. Each circuit is protected by a circuit breaker located on the circuit breaker panel of the main junction box. No fuses are used in this circuit.

These pumps are installed so that the intake lines are connected to the lower elbows. These lines run directly from the fuel strainers. The upper elbows are connected to the lines that run into each nacelle. On each booster pump, a vent line is installed at the junction of the motor drive and the splined shaft of the fuel pump. This line runs through the skin of the ship

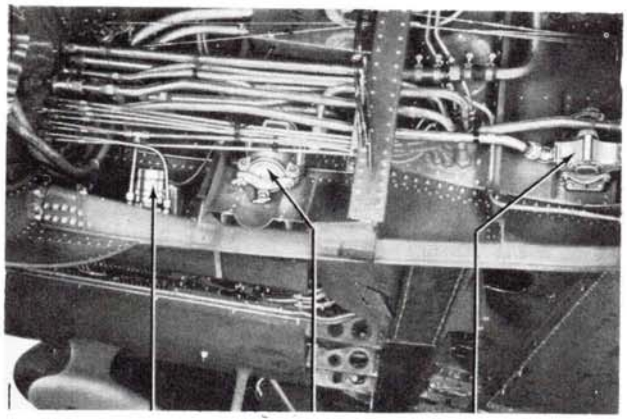


Figure 299—Fuel System Parts Inside Nacelle

1. Engine Primer Solenoid (If Installed)
2. Fuel Strainer
3. Cross-Feed Valve

and vents into the atmosphere to take care of any leakage of gasoline that might otherwise seep into the motor housing.

The motor is an explosion-proof, 24-volt D. C., ⅛ H.P. geared type which runs at approximately 2000 rpm. Lubrication, bearings, and gears are sealed in and should require no additional attention.

(2) REMOVAL.—(See figure 298a). It is possible to remove one or both booster pumps without removing the bracket on which they are mounted or without affecting any cable rigging. The motors of the booster pumps are sealed against moisture and dirt and rarely need servicing. The fuel pumps may be removed from the motors by the following procedure:

(a) Remove skin panels as in procedure for hand operated wobble pumps.

(b) Turn fuel selector valves to "OFF" position. Turn all forward valves of ferry fuel system off.

(c) Disconnect all lines attached to pump to be removed.

(d) Cut the safety wire and remove the four castle nuts holding the pump to the motor housing (4, figure 298a).

(e) Pull the pump straight forward. This will disengage the pump drive shaft from the motor drive gear.

(3) MAINTENANCE, REPAIR OR REPLACEMENT.—Any fuel pump that is not functioning properly should be replaced. Send the defective pump to the depot. Defective electric motors should also be sent to depot.

(4) INSTALLATION.

(a) When installing a new pump, remove the gasket from the motor casting and wipe the surface of the pad clean.

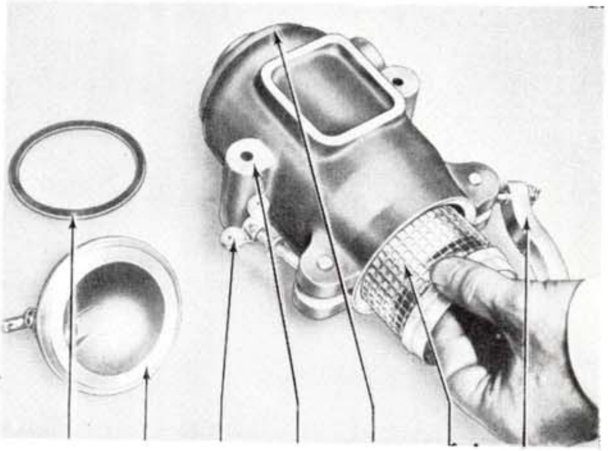


Figure 300—Fuel Strainer Disassembled

1. Gasket
2. Removable Bottom
3. Retainer Bar Wing Nut
4. Boss for Mounting Bolt
5. Barrel
6. Screen
7. Retainer Bar

(b) Remove shipping plugs from the pump ports; remove, also, the wooden block which protects the pad and the drive shaft of the pump. Test the pump for freedom of operation by turning the shaft with the fingers.

(c) Before installing, note carefully location of the intake and outlet ports. Place the gasket in position over the mounting studs and mount the pump in position so that the intake port is on the bottom. Tighten the castle nuts evenly and see that these are properly safetied (4, figure 298a).

(d) Connect the intake line from the fuel strainer to the elbow on the bottom port. Connect the elbow on the discharge port to the line leading to the nacelle. Connect the vent line, using a new piece of hose if necessary.

(5) TEST AFTER INSTALLATION.

(a) With the engine *not* running and the fuel turned *on* at both of the main fuel selector valves, test the booster pump by running it for at least five minutes. At the end of this time the fuel pressure gage should read 17 psi, and there should be no leakage of gasoline at any place. Check the vent opening (2, figure 298a), for the presence of gasoline. Leakage of fuel at this point warrants replacement of the pump.

(b) If the fuel pressure gage shows more or less pressure than **17** psi, adjust the pressure regulator screw on the pressure relief valve housing of the fuel pump as follows:

1. Loosen the lock nut and turn the adjusting screw clockwise to increase the pressure to **17** psi. On

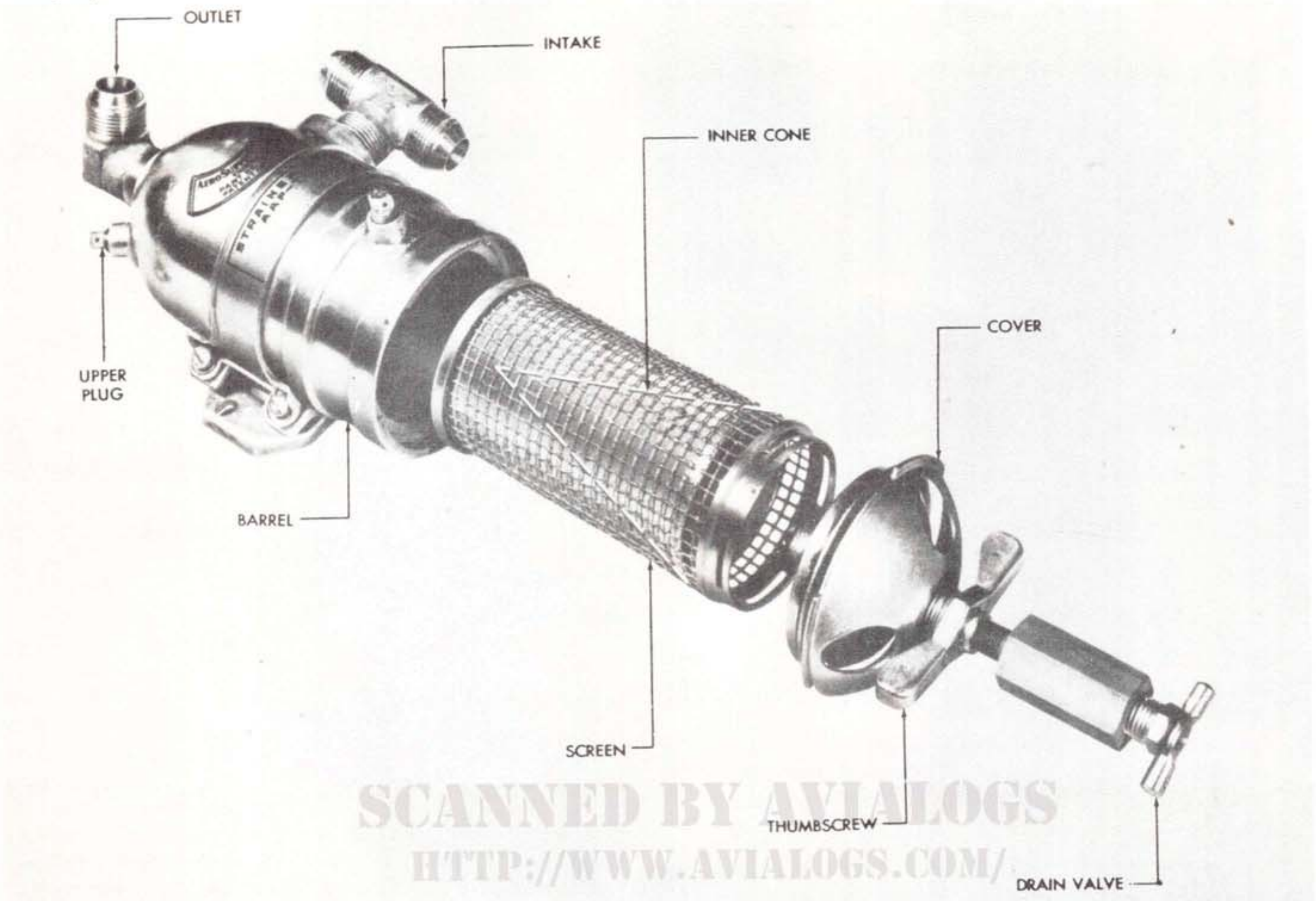


Figure 300A—Fuel Strainer—Late C-47A and C-47B Airplanes

some pumps it will be necessary to remove a lock nut cover (6, figure 298a).

2. Turn the adjusting screw counterclockwise to decrease the pressure to **17** psi.

3. Tighten the lock nut.

Note

> Continually check the vent line and the pressure relief valve housing for any fuel discharge or leakage. Continued discharge or leakage is sufficient cause for rejecting the pump.

(6) MAJOR OVERHAUL.— Booster fuel pump overhaul should be undertaken only at a regular air depot where complete facilities for repair and testing are available. This applies to both electric motors and fuel pumps.

e. FUEL STRAINERS.

(1) DESCRIPTION.—On all C-47 and early C-47A airplanes, the fuel strainers, one for each engine, are mounted on the inboard side of each nacelle (2, figure 299). The words "FUEL STRAINER" are stamped on the outside of each nacelle showing the exact location of the strainer. The strainer is easily accessible from within the nacelle. The strainer is of simple construction consisting of an inlet and outlet fitting, a barrel (5, figure 300), the screen strainer unit (6, figure 300), a removable bottom plate (2, figure 300) secured by a retainer bar (7, figure 300) and wing nut (3, figure 300), and a drain cock. Fuel flows through the inlet side of the strainer unit and passes through the screen on the outlet side.

On late C-47A and all C-47B airplanes, the fuel strainers are located in the center wing, one near each fuel selector valve. The drains to the strainers are outside the airplane, underneath the middle forward portion of the center wing, are painted red, and protrude through each of the access doors marked "TANK SELECTOR VALVE COVER." A disassembly view is shown in figure 300a. Access to this type is made by removing the same panels required to service the selector valves. Drains to both types of fuel strainers must be serviced daily. A visual check of the strainer screen must be made at every 25/30 hour interval of flying time.

(2) REMOVAL AND DISASSEMBLY.—Ordinarily it is not necesary to remove fuel strainers from the

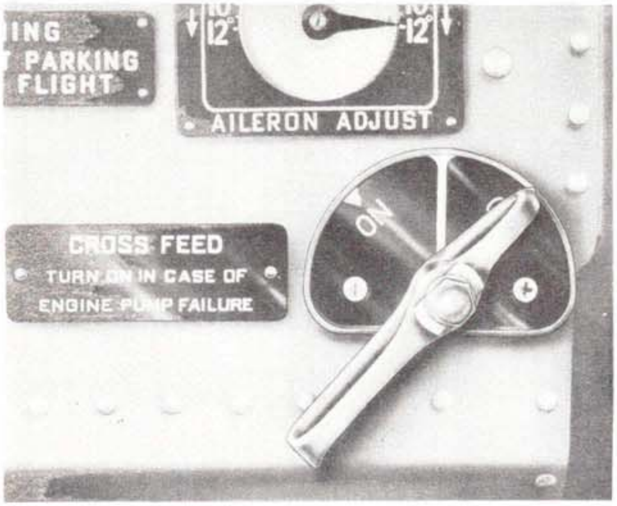


Figure 301—Cross-Feed Valve Control

airplane. If it should become necessary to replace the entire unit, this may be done by disconnecting the lines and taking out the two bolts (4, figure 300) that hold the strainer assembly to its support. A visual inspection of the strainer screen is necessary each 25 hours of flying time. This screen is best removed by the following procedure:

(a) AIRPLANES WITH A STRAINER IN EACH NACELLE (figure 300).

1. Turn fuel system selector valves off. Turn all ferry fuel system valves off.

2. Cut safety wires on wing nut and drain valve.

3. Drain gasoline from strainer.

4. Loosen wing nut and swing up out of the way.

5. Swing bottom cover brace down and out of the way.

6. Remove cover and wire screen strainer.

(b) AIRPLANES WITH STRAINERS IN CENTER WING (figure 300a)

1. Turn main fuel selector valves off. Turn all ferry fuel system valves off.

2. Cut safety wires on drain valve and thumbscrew.

3. Drain gasoline from the strainer through drain valve. Remove plug near top to let air in.

4. Turn thumbscrew to the left. Bell-shaped cover will immediately come loose.

CAUTION

Be sure gasoline drains outside of airplane. Do not allow gasoline to run back inside of center wing. Late C-47B airplanes are equipped with a boot to facilitate drainage outside.

5. Remove screen and cover in one unit.

6. Remove screen from cover by pulling straight out. Use a little force if necessary.

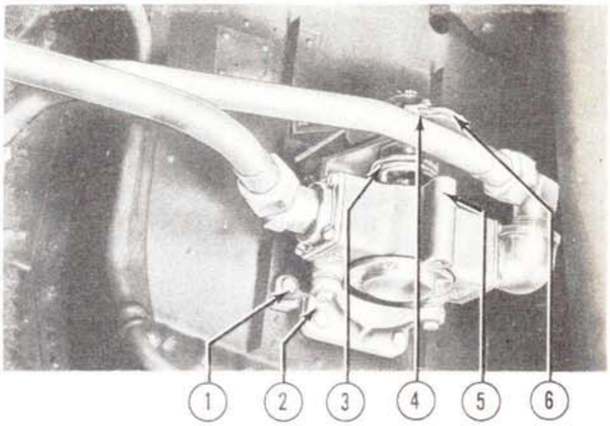


Figure 302—Cross-Feed Valve Installed

1. Attach Bolt
2. Lower Support Bracket
3. Driver Plate and Pins
4. Cable Stop on Control Pulley
5. Bolt Boss
6. Control Pulley

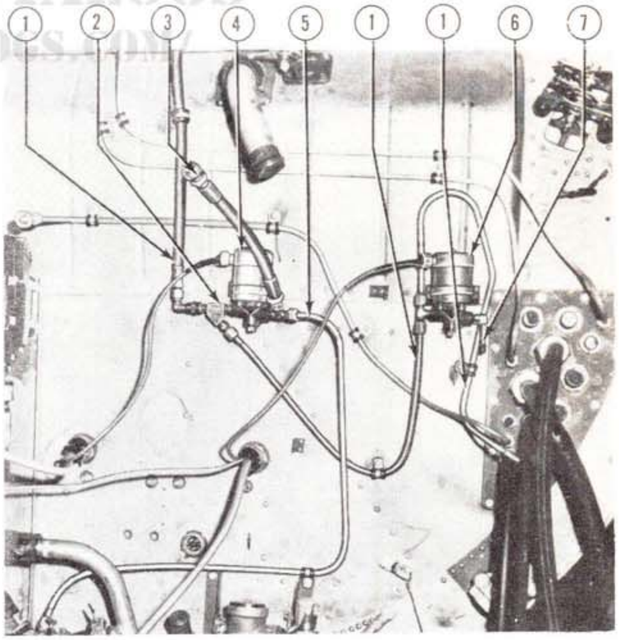


Figure 303—Fuel System Parts on Fire Wall (Installed on Some Airplanes)

1. Fuel Pressure Indicator Line
2. Line to Engine Oil System
3. Restrictor Fitting
4. Oil Dilution Solenoid
5. Oil Dilution Line to Engine Oil System "Y" Drain
6. Outlet Side of Engine Primer Solenoid
7. Engine Primer Solenoid

(3) MAINTENANCE AND REPAIR.

(a) Thoroughly clean the screen and wipe out the strainer barrel.

(b) Examine the gasket (1, figure 300) on the retainer plate on the bottom of the strainer. If the gasket is damaged, remove and replace.

(c) Check the drain cock (figure 299) to see that it is not clogged.

(d) Check the inlet and outlet fittings for leakage; tighten fittings if necessary.

(4) ASSEMBLY AND INSTALLATION.— Both types of fuel strainers are assembled by reversing the procedure for removal, with the exception noted below.

CAUTION

On both types of fuel strainers insert screen strainer into barrel *with pointed end of cone shaped screen up* (figure 300a). If inserted otherwise fuel will pass through coarse part of screen and will not be strained.

Before inserting cover, when strainer is located in center wing, hold bell shaped portion and turn thumbscrew to the left 1½ turns. Insert cover and turn to the right; continue turning the thumbscrew to the right until the cover tightens firmly. When replacing the bottom plate on the strainer located in the nacelle, be sure the drain cock is on the low side next to the nacelle wall.

(5) TEST AFTER INSTALLATION. — After the installation is complete, turn on selector valves and operate wobble pumps or booster pumps to remove air from the system. Check each fuel strainer for any leakage of gasoline. On airplanes with fuel strainers in the nacelles, the pressure accumulated by the wobble pumps is forced into the fuel strainers and fittings. Check these thoroughly for leakage of gasoline after operating the wobble pumps.

f. CROSS-FEED VALVES.

(1) DESCRIPTION. — A cross-feed valve is located on the inboard side of each nacelle, aft of the fuel strainer (3, figure 299). A cross-feed line connecting with the pressure side of each engine-driven fuel pump connects the two cross-feed valves. The valves are operated by cables from a single control on the lower right-hand side of the engine control pedestal. (See figures 301 and 295.) In normal operation these valves are in the "OFF" position, but in case of failure of one of the engine-driven pumps the cross-feed valves may be turned "ON," and pressure from the operating engine-driven pump will pass through the cross-feed system to supply the inoperative engine.

(2) REMOVAL AND DISASSEMBLY.

(a) TO REMOVE THE CROSS-FEED VALVE ONLY.

1. Disconnect the inlet and outlet lines. (See figure 302.)

2. Remove the two bolts holding the lower support bracket to the wall of the nacelle (2, figure 303).

3. Pull the cross-feed valve straight down, disengaging the drive pins from the drive plates (1, figure 303) on top of the valve.

(b) TO REMOVE THE COMPLETE CROSS-FEED VALVE ASSEMBLY.

1. Remove the long narrow panel marked "FUEL AND INSTRUMENT LINES."

2. Working through the access hole marked "ENGINE CONTROLS," disconnect the two turnbuckles (18, figure 295) on the cross-feed valve control cables (figures 295, 290, and 291).

3. Remove the pulley (33, figure 295) over which the upper cable passes. This may be accomplished by removing the cotter key, taking off the nut, and pulling out the bolt.

4. Remove the two pulleys from the brackets mounted on the nacelle wall (33, figure 295). To reach these pulleys, it will be necessary to work between the lines by reaching through the "FUEL AND INSTRUMENT LINES" opening.

5. Pull the cables inside the nacelle.

6. Disconnect the inlet and outlet lines from the cross-feed valve. (See figure 302.)

7. Remove the four bolts (1, figure 302) which hold the cross-feed valve support assembly to the nacelle wall.

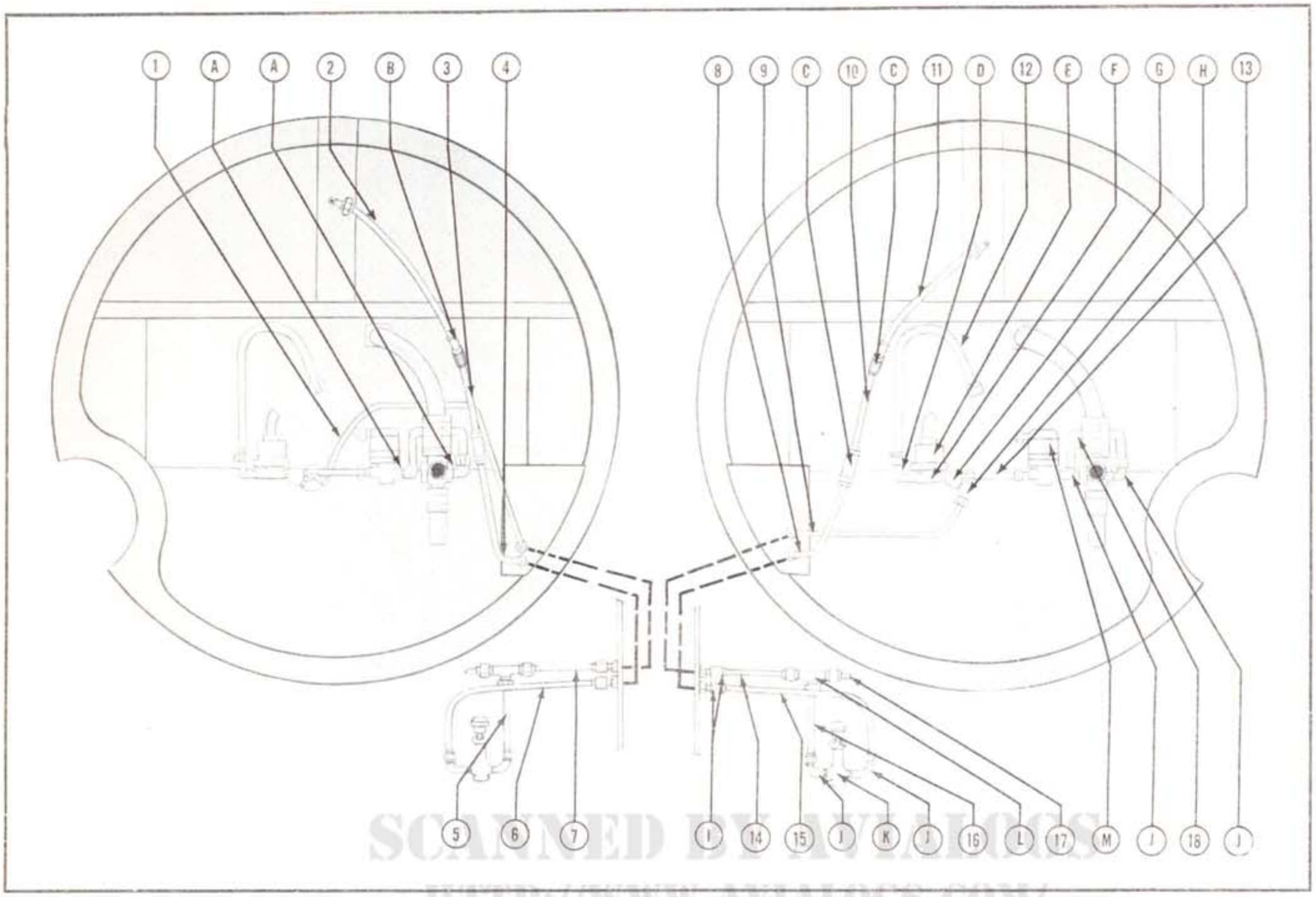

1
A
A
2
B
3
4
8
9
C
10
C
11
D
12
E
F
G
H
13
5
6
7
I
14
15
J
K
J
16
L
17
M
J
18
J

Figure 304—Fire Wall Oil Dilution and Primer Lines Installed on Some Airplanes (Sheet 1 of 2 Sheets)

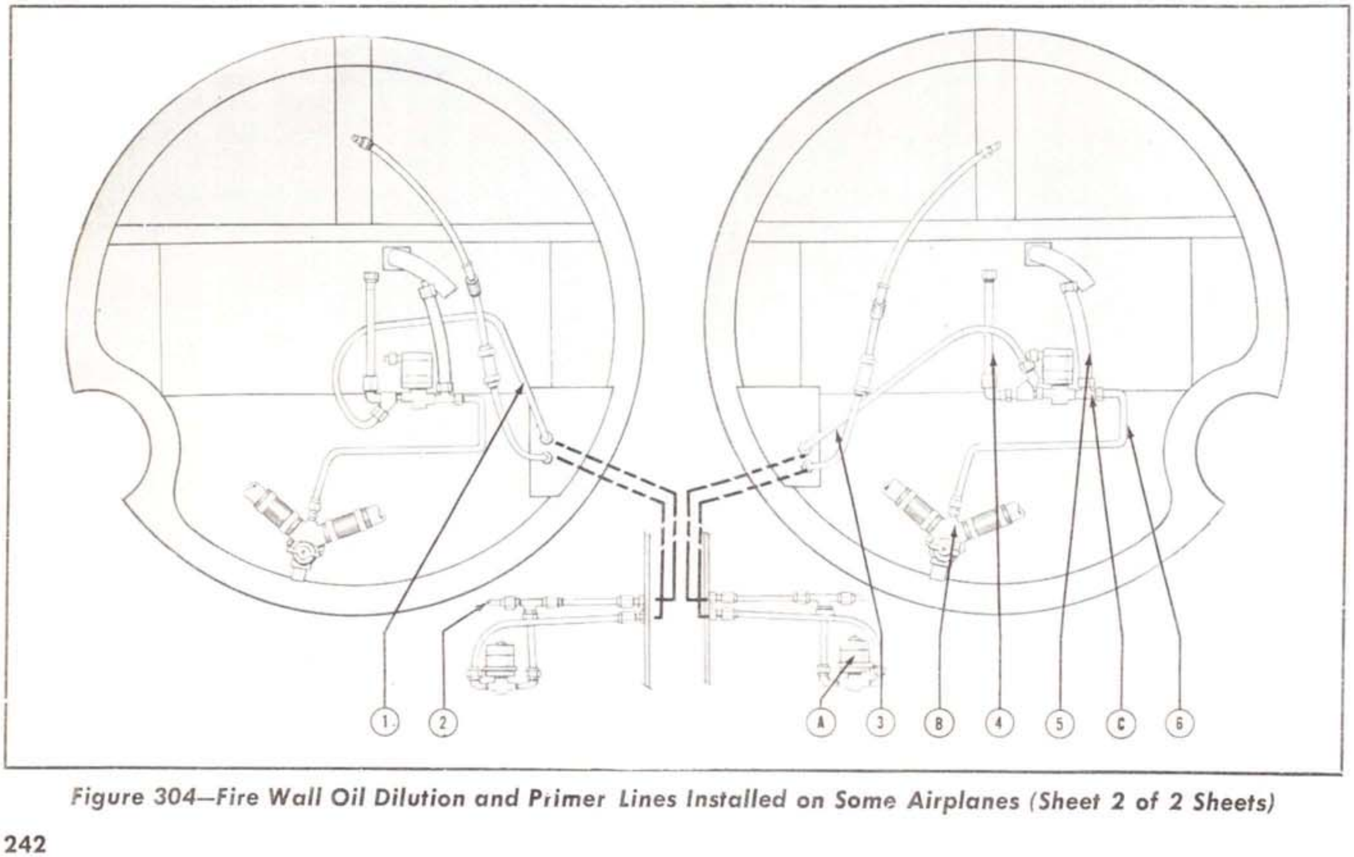


Figure 304—Fire Wall Oil Dilution and Primer Lines Installed on Some Airplanes (Sheet 2 of 2 Sheets)

KEY TO FIGURE 304

Item	*Part No.*	*No. Req*	*Size and Material*	*Lines Length*	*Fittings*	*Ftgs per Line*	*Description*
Sheet 1-1	5112313-19	1	52SO 1/4 OD x .035	32	AF811BT-4D AF811T-4CS	2 2	Fuel Pressure Line—Restrictor fitting to fire wall RH
Sheet 1-2	5112313-20	1	52SO 1/4 OD x .035	18-1/2	AF811BT-4D AF811T-4CS	2 2	Primer Line—Bulkhead fitting to spider RH
Sheet 1-3	5112313-22	1	52SO 1/4 OD x .035	18			Primer Line—Hose to hose RH
Sheet 1-4	5112313-31	1	52SO 1/4 OD x .035	20			Primer Line—Hose to fire wall RH
Sheet 1-5	5112315-38	1	52SO 1/4 OD x .035	3-1/8	AF811BT-4D AF811T-4CS	2 2	Primer to "T"—RH
Sheet 1-6	5112315-37	1	52SO 1/4 OD x .035	9-1/4	AF811BT-4D AF811T-4CS	2 2	Fire Wall to Primer—RH
Sheet 1-7	5112315-39	1	52SO 1/4 OD x .035	9-1/4	AF811BT-4D AF811T-4CS	2 2	Fuel Pressure Line—Fire Wall to "T" RH
Sheet 1-8	5112313-32	1	52SO 1/4 OD x .035	20			Primer Line—Hose to Fire Wall LH
Sheet 1-9	5112313-15	1	52SO 1/4 OD x .035	21	AF811BT-4D AF811T-4CS	2 2	Pressure Warning—Switch to Fire Wall—LH
Sheet 1-10	5112313-21	1	52SO 1/4 OD x .035	19-1/4			Primer Line—Hose to hose LH
Sheet 1-11	5112313-30	1	52SO 1/4 OD x .035	14-1/2	AF811BT-4D AF811T-4CS	2 2	Primer Line—Bulkhead Fitting to Spider LH
Sheet 1-12	2119836-1	2	1/4 ID	19-1/2	014D Weatherhead fittings		Flex Hose—Fuel Pressure—Carb to Pressure Warning Switch
Sheet 1-13	5112313-13	2	52SO 1/4 OD x .035	4-3/8	AF811BT-4D AF811T-4CS	2 2	Pressure Warning Switch to Oil Dilution Solenoid
Sheet 1-14	5112315-44	1	52SO 1/4 OD x .035	6-1/2	AF811BT-4D AF811T-4CS	2 2	Fuel Pressure Line—Fire Wall to "T" LH
Sheet 1-15	5112315-42	1	52SO 1/4 OD x .035	13-1/2	AF811BT-4D AF811T-4CS	2 2	Fire Wall to Primer—LH
Sheet 1-16	5112315-43	1	52SO 1/4 OD x .035	4-1/8	AF811BT-4D AF811T-4CS	2 2	Primer to "T"—LH
Sheet 1-17	5112315-45	1	52SO 1/4 OD x .035	27-1/2	AF811BT-4D AF811T-4CS	2 2	Fuel Pressure Line—"T" to nacelle wall LH
Sheet 1-18	5112313-14	2	52SO 1/4 OD x .035	10-1/4	AF811BT-4D AF811T-4CS	2 2	Oil Dilution Solenoid to Oil Drain
Sheet 2-1	5112313-43	1	52SO 1/4 OD x .035	32	AF811BT-4D AF811T-4CS	2 2	Fuel Pressure Line—Restrictor fitting to fire wall RH
Sheet 2-2	5112315-40	1	52SO 1/4 OD x .035	23-5/8	AF811BT-4D AF811T-4CS	2 2	Fuel Pressure Line—"T" to nacelle wall RH
Sheet 2-3	5112313-42	1	52SO 1/4 OD x .035	26	AF811BT-4D AF811T-4CS	2 2	Fuel Pressure Line—Restrictor fitting to fire wall LH
Sheet 2-4	2119836-1	2	1/4 ID	19-1/2	014D Weatherhead fittings		Flex Hose—Fuel pressure—Carb to restrictor fitting
Sheet 2-5	2119836-3	2	1/4 ID	9-7/8			Flex Hose—Oil dilution solenoid to main engine oil line
Sheet 2-6	5112313-48	2	52SO 1/4 OD x .035	38-3/4	AF811BT-4D AF811T-4CS	2 2	Oil Dilution Line—Oil dilution solenoid to oil system "Y" drain

KEY TO FIGURE 304—Continued

PARTS AND FITTINGS

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
Sheet 1-A	AF811FT-4	Nipple	4
Sheet 1-B	AF811CT-4	Elbow	2
Sheet 1-C	3706H-4-9	Hose	4
Sheet 1-D	AF811CT45°-4	Elbow	2
Sheet 1-E	3110	Pioneer Pressure Warning Switch	2
Sheet 1-F	-2-2-2MMS	Parker "T"	2
Sheet 1-G	AF37A3528	Restrictor Fitting	2
Sheet 1-H	CCT-4	Parker Elbow	2
Sheet 1-I	3115-1HT-4D	Parker Coupling	4
	11-1039-1-3D	Parker Lock Nut	4
Sheet 1-J	AF811CT-4	Elbow	8
Sheet 1-K	No. 401-1A	Parker Hand Primer	2
Sheet 1-L	AF811JT-4	Tee	2
Sheet 1-M	AF37D6210	Type M-441-M2 Oil Dilution Solenoid	2
Sheet 2-A	AF37D6210	Type M-441-M2 Engine Primer Solenoid	2
Sheet 2-B	AF811FT-4	Nipple	2
Sheet 2-C	AF811RT-4	Tee	2

8. Remove the cross-feed valve assembly.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) Check the gaskets of the valve port; replace if damaged.

(b) If any other parts are faulty, the complete cross-feed valve (figure 302) should be replaced.

(4) INSTALLATION.—Install the cross-feed valve assembly by reversing the removal procedure.

(5) ADJUSTING THE CROSS-FEED VALVE INDICATOR.

(a) Connect the control cables at the turnbuckles (18, figure 295) inside the access hole marked "ENGINE CONTROLS" and adjust so that the threads on the turnbuckle bolts are covered.

Note

Do not tighten the cables beyond this light tension.

(b) Move the cross-feed indicator (figure 301) on the control pedestal to a straight up and down, or neutral, position and hold it in this position.

(c) While the cross-feed indicator is being held in the neutral position, turn the control pulley (6, figure 302) on top of the cross-feed so that the cable stop (4, figure 302) is directly in line with the bolt boss (5, figure 302) on the side of the cross-feed valve. The valve is now in the neutral position.

(d) Tightening the turnbuckles (18, figure 295) on the upper and lower cables alternately; adjust the control cables to 30-pounds tension.

(e) Move the indicator in the pilots' compartment to the "OFF" position (figure 301) and double check to make certain the cross-feed valve is also in the "OFF" position.

(f) Do not try to force the indicator. Make all adjustments by using the turnbuckles provided on the control cables.

g. FUEL PRESSURE GAGE LINE.—The fuel-pressure gage line (1, figure 303) is mounted on the face of each fire wall and connects from the back of the carburetor to its respective fuel pressure gage on the pilots' instrument panel. There is a restrictor fitting (2, figure 303) in the fuel-pressure gage line and the oil dilution solenoid (4, figure 303) is connected to one side of this restrictor. Beyond the oil dilution solenoid an engine primer solenoid (6, figure 303) is connected by a "T" fitting to the fuel pressure gage line. The line then leads back through the fire wall to the fuel pressure gage.

h. OIL DILUTION SOLENOID AND ENGINE PRIMER SOLENOID.

(1) DESCRIPTION.

(a) OIL DILUTION SOLENOID.—The oil dilution solenoid (4, figure 303), connected to the restrictor fitting in the fuel pressure gage line, is provided for the dilution with fuel of both the engine oil and the propeller feathering oil. The solenoid is controlled by a toggle-type switch on the pilots' electrical panel. When the switch is in the "ON" position and the oil dilution solenoid is energized, fuel passes through the solenoid into a line connecting with the engine oil system (3, figure 303) and through another line (5, figure 303) leading to the engine oil "Y" drain valve which is connected to the propeller feathering motor. Refer to figure 304 for illustrations of other oil dilution solenoid installations that have been used on this airplane.

(b) ENGINE PRIMER SOLENOID.—The engine primer solenoid (6, figure 303) connects into the

fuel pressure gage line through a "T" fitting. The solenoid is identical to the oil dilution solenoid and is operated by a toggle-type switch mounted next to the oil dilution switch on the pilots' electrical panel. When the engine primer solenoid is energized, fuel flows from the fuel pressure gage line (1, figure 303) through the solenoid and to the engine, where, through a spider fitting and individual lines, the fuel is injected into the top eight cylinders to prime the engine for starting. On some airplanes, the engine primer solenoid was mounted in the nacelles (1, figure 299).

(2) REMOVAL.—The oil dilution solenoid and the engine primer solenoid may be removed from the fire wall by disconnecting the electrical wiring, and the fuel pressure gage line, and unscrewing the nuts from the "U" bolt that secures the solenoid to the support bracket.

(3) MAINTENANCE REPAIR AND REPLACEMENT.—No repair of either the oil dilution solenoid or engine primer solenoid is suggested other than removal of the drain plug on the bottom of the solenoid to remove any residue or foreign substance that may be present. In case of failure of either of the solenoids, the unit should be replaced.

(4) INSTALLATION.—The oil dilution or engine primer solenoids may be installed by reversing the removal procedure.

(5) TEST AFTER INSTALLATION.

(a) Disconnect the line on the outlet side of the solenoid (7, figure 303).

(b) With the control switch in the pilots' compartment in the "OFF" position, operate the hand wobble pump. There should be no leakage from the outlet side of the solenoid.

(c) With the control switch in the "ON" position, operate the hand wobble pumps until a clear flow of fuel is passing through the solenoid. Then with the valve seated (switch off), the leakage should not exceed 10 drops per minute.

i. ENGINE-DRIVEN FUEL PUMP.

(1) DESCRIPTION. – An engine-driven fuel pump (figure 305) is mounted on the back of each engine and is operated by means of a drive shaft coupled with the engine drive gear. Any type G-9 aircraft fuel pump may be used on this airplane. This pump is a four-blade rotary type with an inlet and outlet port and an adjustable pressure relief valve which maintains a constant fuel pressure at varying engine speeds. The pressure relief valve is a spring-loaded diaphragm that opens when the pump is operating at high speed and allows excess fuel to flow back into the intake chamber. At low operating speeds, the pressure relief valve closes and allows the full flow of fuel to pass through the outlet port. Two lines tee into the outlet or pressure side of the pump. (See figure 305.) One line leads to the engine and the other line connects with the cross-feed system. A drain line is connected to the diaphragm vent boss to allow for the drainage of any small amount of fuel that might leak around the diaphragm. A bypass valve is incorporated in the fuel pump to allow fuel to flow around the engine-driven pump when the hand-operated wobble pumps are being used.

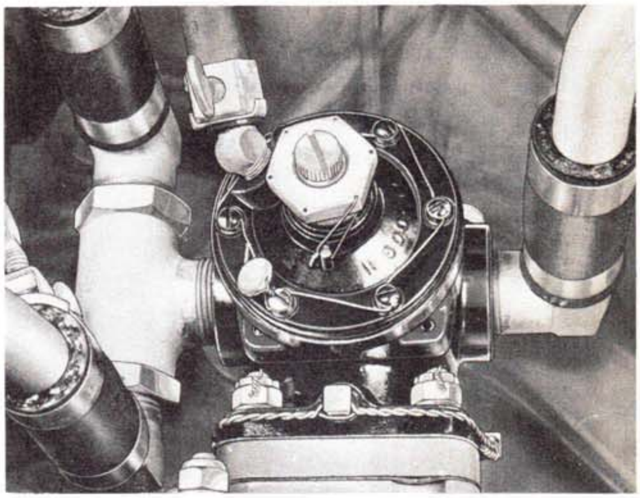


Figure 305—Engine-Driven Fuel Pump, Showing Pressure-Adjusting Screw

(2) REMOVAL.

(a) Disconnect all lines (figure 305) attached to the engine-driven pump.

(b) Cut the safety wire and remove the four screws in the mounting bracket. (See figure 305.)

(c) Pull the pump straight back. This disengages the gear on the pump drive shaft from the engine drive gear.

(3) MAINTENANCE REPAIR OR REPLACEMENT. – Any engine-driven fuel pump that is not functioning properly should be replaced. Send the replaced pump to the depot for repair.

(4) INSTALLATION.

(a) When installing a new engine-driven pump, remove the cover plate and gasket from the engine fuel pump drive and wipe the pad clean. Remove the shipping plugs from the pump ports and test the pump for freedom of operation by turning the shaft with the fingers. If the shaft does not turn freely, knock the assembly gently on a wooden bench or block to free the parts.

(b) Before mounting the pump on the engine, note carefully the direction of rotation of the drive gear, and the position of the relief valve housing. Rotate the relief valve housing, as necessary, to insure that the bypass valve is in the correct position. Then place the new gasket in position over the mounting studs and mount the pump in the position most desirable for necessary connections. Tighten the mounting nuts evenly and see that they are properly safetied. (See figure 305.)

(c) Connect the intake, discharge, and drain

lines to the proper pump ports. The discharge port for either direction of rotation is designated by arrows on the name plate fastened to the end of the pump body. It is advisable to use a length of flexible tubing at or near the pump ports to insure against tube fracture which may result from engine vibration. (See figure 305.)

(5) TEST AFTER INSTALLATION.—With the engine-driven pump installed and the engine turning 2300 to 2400 rpm (manifold pressure at 30 in. Hg) the fuel pressure gage should read 17±1 psi. If the fuel pressure gage shows more or less pressure than 17±1 psi:

(a) Adjust the pressure regulator screw on the bottom of the pressure relief valve housing on the engine-driven pump. (See figure 305.)

1. Loosen the lock nut and turn the adjusting screw clockwise to increase the pressure.

2. Turn the adjusting screw counterclockwise to decrease the pressure.

3. Tighten the lock nut.

(b) Check the two drain lines on the engine-driven pumps for any fuel discharge. Continued leakage from either drain line is sufficient cause for rejecting the pump.

(c) Idle the engine and watch the fuel pressure gage for change in fuel pressure. There should be a drop of approximately 2 pounds pressure. If the pressure drops to 14 pounds or lower when the engine is turning at idle speed, the pump should be replaced.

Note

Some fluctuation in fuel pressure may be caused by air in the lines. Operate the wobble pump and then recheck the fuel pressure gage. This will often clear the lines and cause the fuel pressure gage to operate correctly.

(6) MAJOR OVERHAUL. — Engine-driven fuel pump overhaul should be undertaken only at a regular repair depot where complete facilities for repair and testing are available.

j. LIQUIDOMETER.—For information concerning the liquidometer system used for measuring fuel quantity, refer to paragraph 14.*c.*(7), this section.

k. LONG RANGE (FERRY) FUEL SYSTEM. *(See figures 306, 307, 307a, 307b and 307c.)*

(1) DESCRIPTION.—Provision for carrying fuel for long range operations may be made by installing tanks in the cargo compartment of the airplane.

CAUTION

The ferry fuel system must not be used at the same time the main fuel system is in use. When the ferry fuel tanks are in use, the main fuel supply selector valves must be turned to the off position. If both systems are turned on at the same time, the fuel will flow down from the ferry fuel tanks through the main selector valve into the main fuel tanks. If these are already full, the fuel will flow out through the wing tank vent lines creating a dangerous fire hazard, a loss of fuel, and a greatly shortened flying range.

(2) Assembly and installation.

(a) Lift forward left and right personnel seats in cargo compartment and wire in up position as shown in figure 307B.

(b) Remove rubber mat from center walkway between station 177.50 and 250.50 to uncover tie-down bolt anchorages.

(c) Remove the walkway board in the radio-navigator's compartment.

(d) Place Beam (A-figure 307A) against the forward side of the left fuselage frame at station 195.50 with the notched end outboard and mark the beam for drilling by marking through the existing holes in the frame. Place Beam (B-figure 307A) in similar position on the right side and mark for drilling.

(e) Place Beam (C-figure 307A) against the forward side of the left fuselage frame at station 234.50 and mark for drilling as above. Beam (D-figure 307A) is placed against the forward side of the right fuselage frame at station 234.50 and marked for drilling.

(f) Remove the beams and drill the holes as marked. Reinstall beams in proper positions and bolt to frame.

CAUTION

Do not enlarge or drill additional holes in the frames of the aircraft.

(g) Center a plate (E-figure 307A) over the joint of the two forward beams and one over the joint of the two aft beams drilling six holes through each beam end and the plates. Bolt the plates to the beams.

(h) Place a tank assembly (F-figure 306) in each of the two cradles formed by the beams, each tank having its filler neck up and toward the aft end of the plane. The forward end of the tanks should

extend 8¼ inches past the forward beam. Secure two strap assemblies around each tank by fastening their ends to the drilled angles on the beams with cotter pins. Draw straps tight by means of attached turnbuckle which are then safetied.

(i) Bolt tank drag brace to floor tie down fitting at station 201.750, safety bolt to brace.

(j) Install the bracket (G-figure 307C) at station 240.50. Mount valve, type D on the bracket with the outlet opening forward. Fasten a brace (H-figure 307C) to each side of the bracket using the short flattened end.

(k) Mount the valve assembly (J-figure 307C) at the tiedown anchorage in catwalk, station 186.625, with the outlet from each valve pointing forward. Connect the tube assembly, (K-figure 307C) to the Type D valve and attach it to the cross. Connect the cross and the forward valve assembly with tube assembly (L-figure 307C). Place one elbow in the outlet on the lower side of each tank and connect the elbow to the cross with tube assemblies (M-figure 307C).

Note

> Bond metal parts in accordance with applicable technical orders.

(l) Place the 2x12 inch walkway across the beams allowing it to extend 12.5 inches aft of the rear beam. Attach the tank drag brace to the underside of the walkway and the two braces (H-figure 307C) to each side of the walkway. Bolt the Support Assembly—tank drag (N-figure 306) to each end of the walkway tight against the tanks.

(m) Insert one adapter in the vent opening on the upper forward end of each tank. Connect each adapter to a vent tube (0-figure 307C) with a rubber tube and secure with hose clamps. The lower end of each vent line is attached to an outlet in the skin at fuselage station 175.50 by means of a rubber tube.

(n) Connect a tube assembly (P-figure 307C) to each valve on the forward valve assembly and fasten one elbow to each tube assembly at fuselage station 177.50 with the open end of the elbow pointing down (figure 307). Using the tube assembly (line to strainer) connect the system into the fuel strainer.

(o) If the walkway in the radio-navigator's compartment has been notched to receive the ferry fuel tank, reinstall the board. If it has not been notched, tie it securely in the baggage compartment with rope and use Board Assembly as furnished in its place.

(3) TEST AFTER INSTALLATION.—After installation the ferry fuel system must be tested thoroughly to prevent leaks and the consequent danger

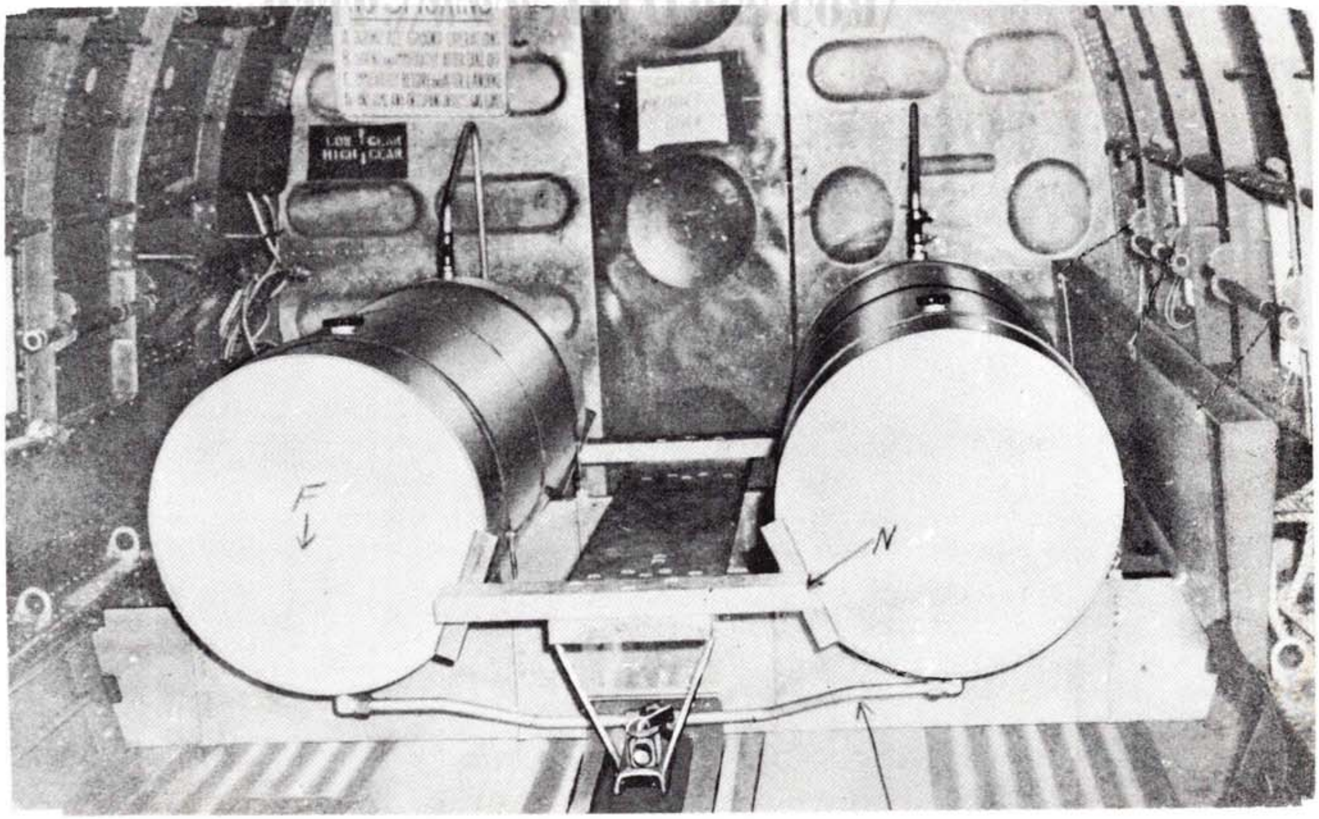


Figure 306—Long Range Fuel Tank Installation

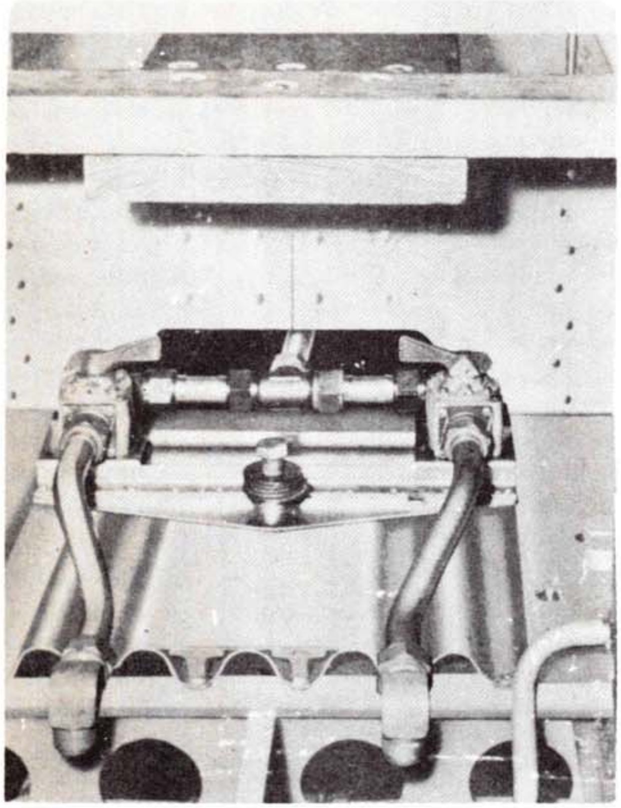


Figure 307—Fuel Valve Installation Front

of fire and explosion. The system will be checked by the mercury method whenever possible. Whenever activity locations prohibit the mercury check an air and soap suds check will be used by qualified personnel.

l. FLUID SHUT-OFF VALVE CONTROLS. *(See figure 307D.)*

(1) DESCRIPTION.—There is a fluid emergency shut-off control system which incorporates shut-off valves just aft of the fire wall on the hydraulic, oil, and fuel lines. These are connected by cables through the center wing and along the fuselage, connecting to handles located under the access door to the fire extinguisher system on the floor between pilot's and co-pilot's seat. In case of fire in either engine, the corresponding handle is pulled, which in turn shuts off the hydraulic, oil, and fuel systems to that engine.

(2) REMOVAL AND DISASSEMBLY. *(See figure 307D.)*

(a) Break the lock wire on the turnbuckles and disconnect the cables at the turnbuckles near the bell crank in each nacelle.

(b) Remove the center floor panel aft of the control pedestal.

(c) Working through this opening, disconnect the clevis and pin connections.

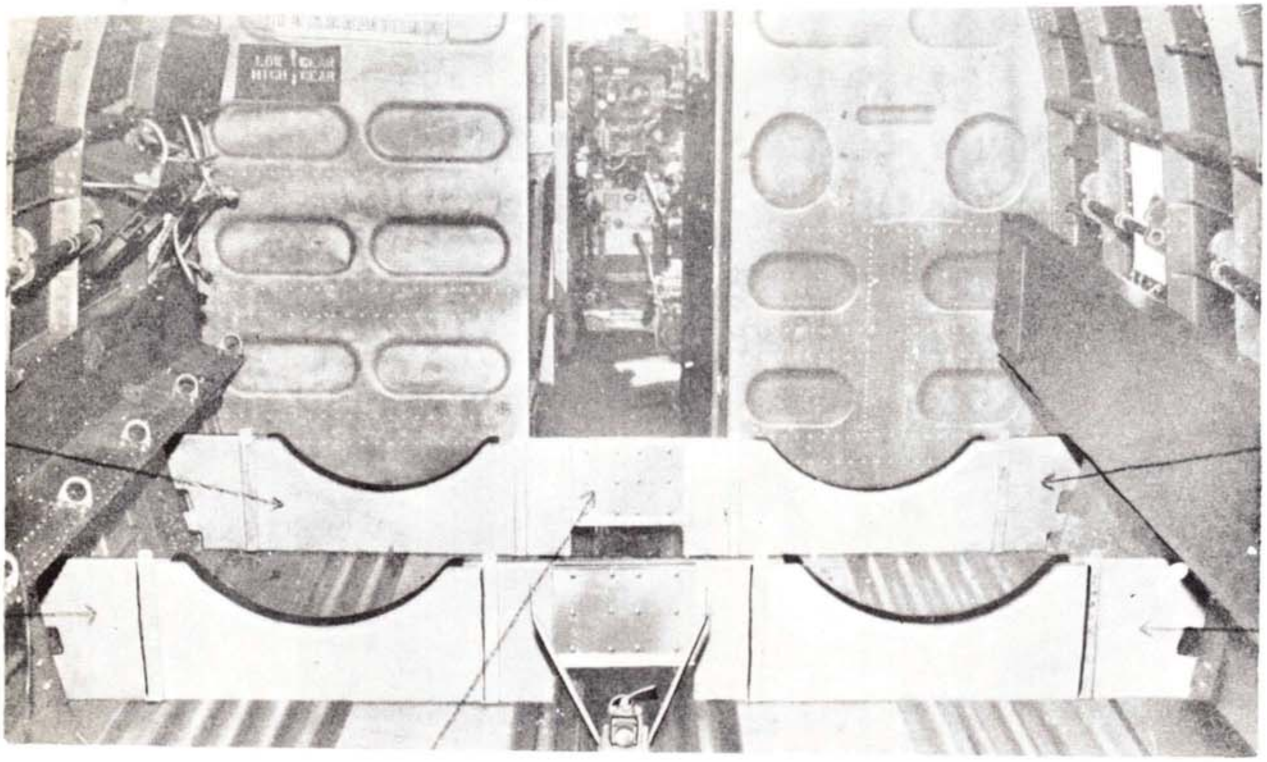


Figure 307A—Beam Installation

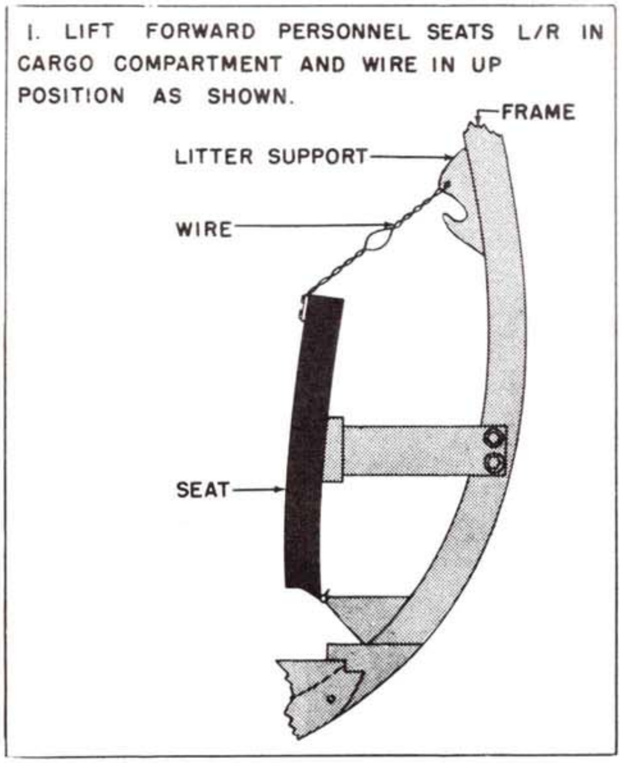

1. LIFT FORWARD PERSONNEL SEATS L/R IN CARGO COMPARTMENT AND WIRE IN UP POSITION AS SHOWN.
FRAME
LITTER SUPPORT
WIRE
SEAT

Figure 307B—Personnel Seat—Wiring in UP Position

(d) Remove the guard pins from the pulley cluster in the center wing. This pulley cluster may be reached through the selector-valve access holes located at the forward edge of the center wing section to the left and right of the airplane center line.

(e) Pull the fluid shut-off control cables through the pulley cluster into the nacelle.

CAUTION

Pull the cables through the pulley cluster slowly and carefully so that there is no danger of chipping the Micarta pulleys.

(3) MAINTENANCE REPAIR AND REPLACEMENT.

(a) Inspect all pulleys; replace those found to be damaged.

(b) Check all cables and replace those which have more than six wires broken in any 1-inch length. (Replace any cables with broken wires which travel over a pulley.)

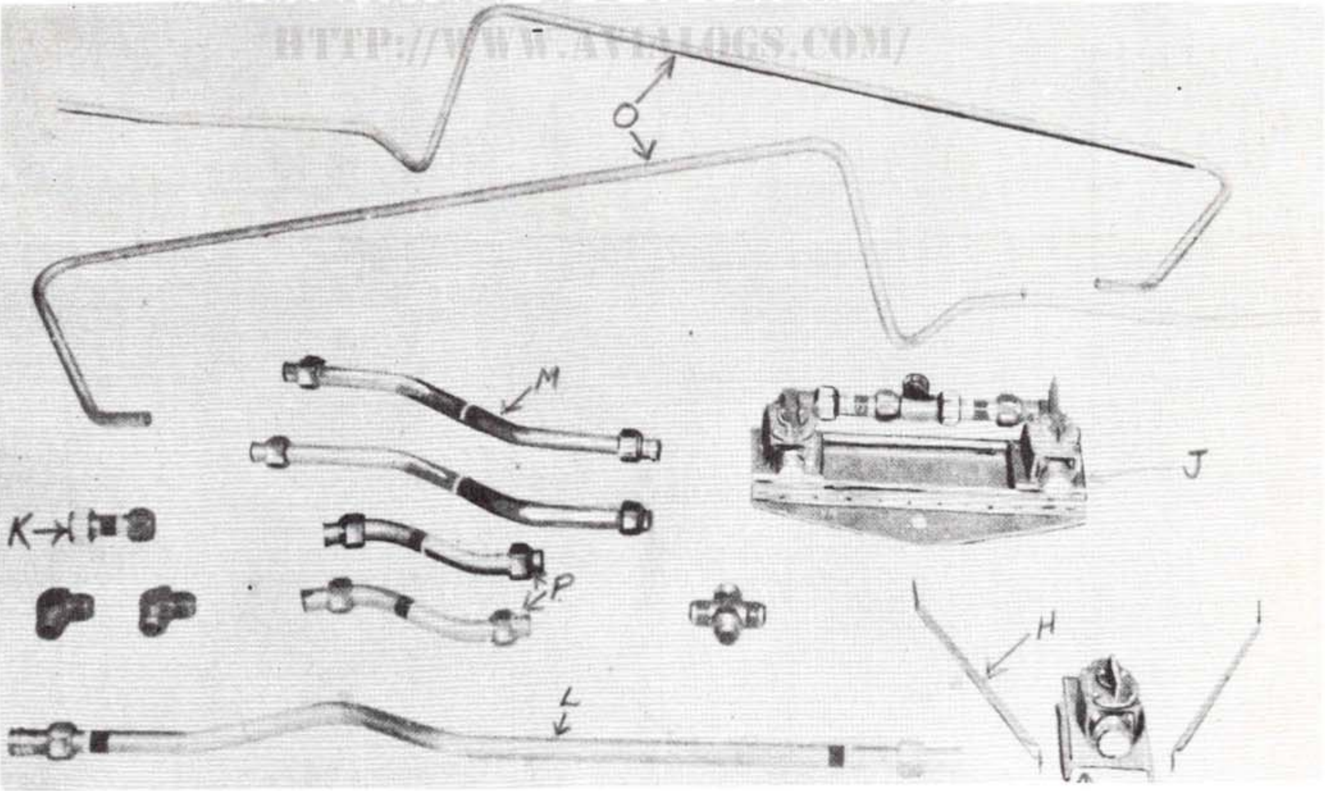


Figure 307C—Tubing Assembly

m. TROUBLE SHOOTING, FUEL SYSTEM.

Trouble	*Possible Cause*	*Remedy*
LACK OF FUEL PRESSURE.	No fuel in tanks.	Fill fuel tanks.
	Broken or disconnected lines.	Repair or replace lines. (Refer to figure 628.)
	Fuel tank selector valve not in correct position.	Turn control handle to proper position. Check adjustment of controls. (Refer to paragraph 10.*c*.(5), this section.) Check condition of selector valve. (Refer to paragraph 10.*c*.(3), this section.)
	Defective fuel pressure indicator	Replace fuel pressure indicator.
	Clogging of fuel pressure gage lines or main fuel lines.	Remove stoppage.
	Clogging of fuel tank vent lines.	Remove stoppage.
	Cuts in lines due to clamps, screws, or bolts.	Repair or replace lines. (Refer to figure 628.)
	Malfunctioning of engine-driven fuel pump, such as ruptured diaphragm, or sheared drive shaft.	Check engine-driven fuel pump and replace if necessary.
	Clogged fuel strainer.	Clean strainer. (Refer to paragraph 10.*e*.(2)(3) and (4), this section.)
	Bottom plate on fuel strainer loose.	Put plate in place and safety wing nut (2, figure 299).
	Clogged restrictor fitting.	Clean restrictor (3, figure 303).
	Hose which is not resistant to aromatic fuels used in place of approved hose.	Replace with approved hose, Specification No. AN-ZZ-H-456.
LOW FUEL PRESSURE.	Defective fuel pressure indicator.	Replace fuel pressure indicator.
	Damaged fuel tank selector valve.	Replace fuel tank selector valve. (Refer to paragraph 10.*c*.(4), this section.)
	Loose line connection.	Tighten fittings.
	Improperly adjusted engine-driven fuel pump.	Adjust pressure adjusting screw on engine-driven fuel pump. (See figure 305.)
	Clogging of fuel lines.	Remove obstruction.
	Malfunctioning of engine-driven pump.	Check drain lines on engine-driven fuel pump for leakage or stoppage. Clean drain lines, or replace pump if necessary. (Refer to paragraph 10.*i*.(4) and (5), this section.)

Trouble	*Possible Cause*	*Remedy*
LOW FUEL PRESSURE—Cont'd.	Fuel leakage through engine primer line or oil dilution line.	On airplanes equipped with hand primer, check to see that primer is closed. On airplanes equipped with primer solenoid, check solenoid for dirt under valve in solenoid. Check oil dilution solenoid in the same way. (Refer to paragraph 10.*b*.(5), this section.)
	Clogged fuel strainer.	Disassemble and clean fuel strainer. (Refer to paragraph 10.*e*.(2)(3) and (4), this section.)
	Clogged restrictor fitting.	Clean restrictor (3, figure 303).
	Hose which is not resistant to aromatic fuels used.	Replace with approved hose, Specification No. AN-ZZ-H-456.
HIGH FUEL PRESSURE.	Improper setting of pressure adjusting screw on engine-driven fuel pump.	Make proper adjustment. (Refer to paragraph 10.*i*.(5), this section.)
	Defective fuel pressure indicator.	Replace fuel pressure indicator.
	Failure of bypass valve on engine-driven fuel pump. (Indicated by normal fuel pressure at idle speed with an increase to extreme high pressure as rpm increases.)	Replace engine-driven fuel pump.
	Clogging of carburetor return line.	Clear obstruction from line.
IMPROPER CARBURETION.	(Refer to section IV, paragraph 6.*b*.(10)*(b)*6., trouble shooting.	

11. INSTRUMENTS AND AUTOMATIC PILOT.

a. GENERAL.—All instruments on the C-47 and C-47A airplanes are installed in the pilots' and navigator's compartments. All electrically-actuated instruments are discussed in paragraph 14., this section. Navigation instruments are discussed in paragraph 2., section V. All instruments which have been installed on the C-47 and C-47A airplanes are listed in the instrument chart, section IV, paragraph 11.*b*.

b. MAIN INSTRUMENT PANEL.
(See figures 308 and 309.)

(1) DESCRIPTION.—The main instrument panel is fabricated in sections which are bolted together to form a single unit. The panel is attached to the airplane structure by means of five shock absorbing mounts. The panel illumination consists of six lamps; three are fluorescent and three are incandescent. The lamps are located on the control pedestal and on each side of the pilots' compartment.

(2) REMOVAL.

(a) Disconnect all lines and wires attached to the instrument. Label each line and wire to facilitate reassembly.

(b) Remove the center bolts from the five shock mounts.

(c) Remove the instrument panel.

(d) If the shock mounts are to be replaced, remove the four bolts which attach each mount to its bracket.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) Damage to the instrument panel cannot be repaired. Replace the damaged section.

(b) Replace worn or nonresilient shock absorbers. Note that at the top of the panel the absorbers are installed with the load side out. On the bottom of the panel the load sides face each other. The load side is the one which carries the part number.

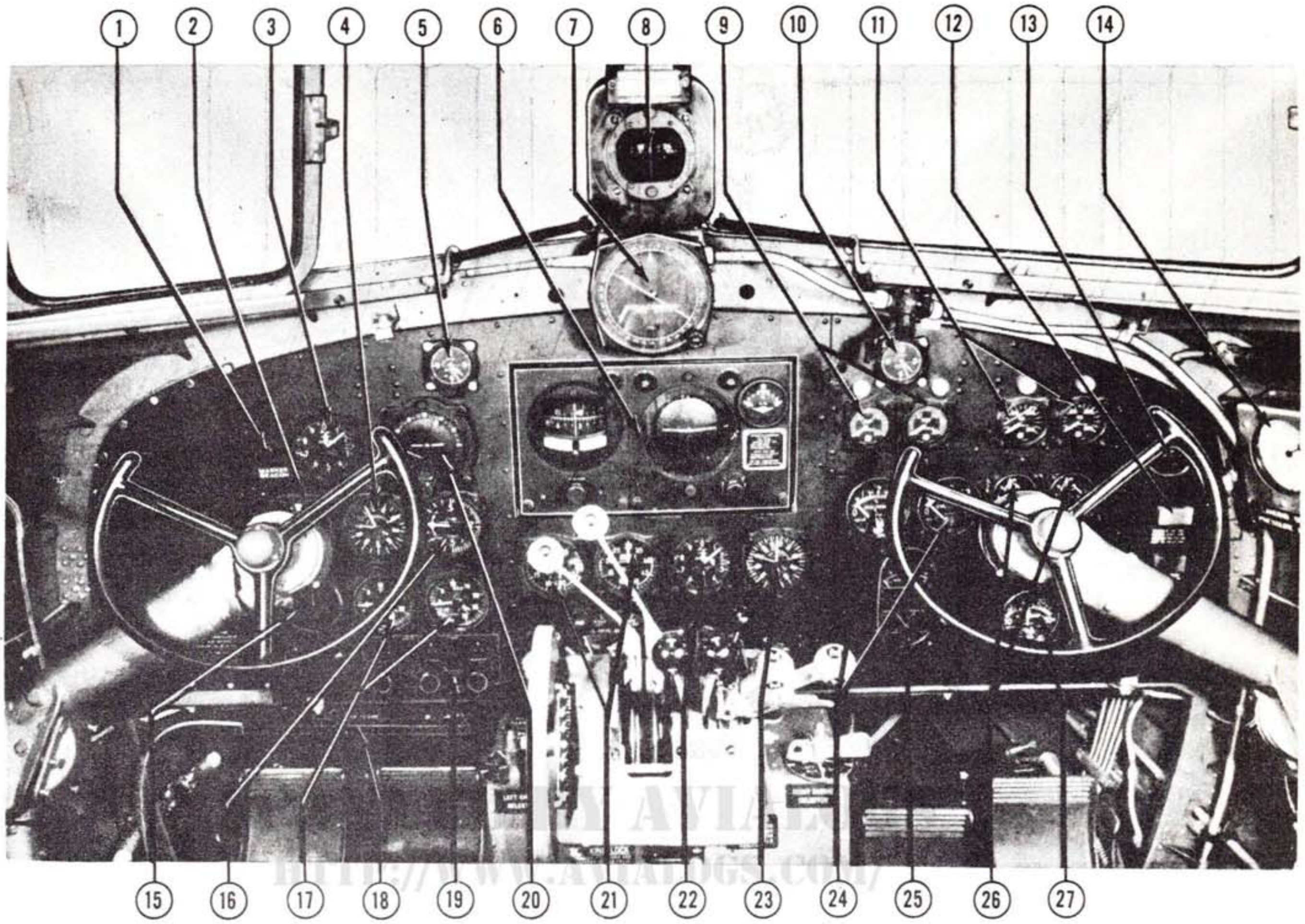


Figure 308—C-47 Instrument Panel

(Douglas Dwg. 5110986)

1. Marker Beacon Indicator
2. Bank and Turn Indicator
3. Altimeter
4. Airspeed Indicator
5. Clock
6. Sperry Automatic Pilot
7. Azimuth Indicator
8. Pilots' Direct Reading Compass
9. Fuel Pressure Gages
10. Clock
11. Oil-Pressure Gages
12. Landing-Gear Warning Lamps
13. De-Icer Pressure Gage
14. Landing-Gear Pressure Gage
15. Radio Compass Indicator
16. Rate-of-Climb Indicator
17. Tachometers
18. Wing Flap Position Indicator
19. Speed Control Valve Assembly
20. Gyro Horizon
21. Manifold Pressure Gages
22. Altimeter
23. Air Speed Indicator
24. Cylinder Head Temperature Indicators
25. Fuel Quantity Gage
26. Oil-Temperature Indicators
27. Outside Air Temperature Indicator

(c) Instrument safety range and danger markers which have been damaged or obliterated shall be replaced using fluorescent markers, types 2 and 3, AAF Specification No. 17012. These markers may be obtained from Air Force Stock, and will be cut to the proper length on installation. The method of application of the decalcomanias is as follows:

1. Clean the surface to which the marker is to be applied with liquid glass cleaner, AAF Specification No. 14099.

2. Coat the area to be covered by the marker with a thin coat of varnish, decalcomania adhesive, AAF Specification No. 14123. It is recommended that the width of application of the varnish be slightly wider than the decalcomania.

3. Immerse the marker in water not longer than 10 seconds.

4. Remove from the water and lay face up for approximately 30 seconds on card which is contained in the package.

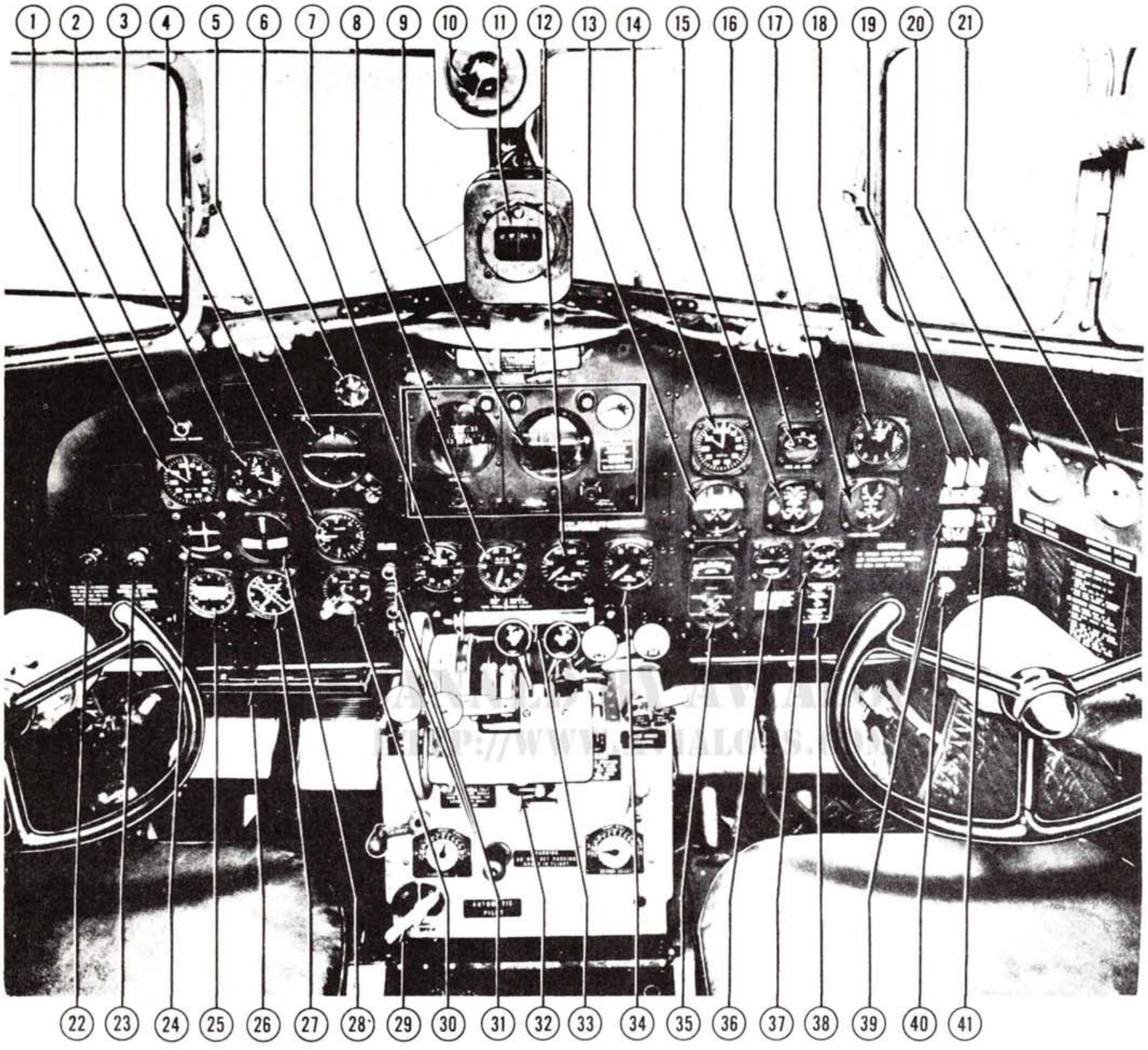


Figure 309—C-47A Instrument Panel

(Douglas Dwg. 5202165)

1. Air Speed Indicator
2. Marker Beacon Indicator Lamp
3. Altimeter
4. Rate-of-Climb Indicator
5. Gyro Horizon
6. Clock
7. Manifold Pressure Indicator (Dual)
8. Tachometer (Dual)
9. Automatic Pilot (Jack & Heintz)
10. Radio Altimeter Altitude Limit Switch
11. Magnetic Compass
12. Oil-Pressure Indicator (Dual)
13. Oil Temperature Indicator (Dual)
14. Air Speed Indicator
15. Cylinder Head Temperature Indicator (Thermocouple Thermometer) (Dual)
16. Free Air Temperature Indicator
17. Carburetor Air Temperature Indicator (Dual)
18. Altimeter
19. Heating and Ventilating Warning Lamps
20. Landing-Gear Pressure Gage
21. Hydraulic System Pressure Gage
22. Windshield Anti-Icer Control
23. Windshield Wiper Control
24. RC-103-( ) Radio Indicator
25. Radio Compass Bearing Indicator
26. Wing Flap Position Indicator
27. Remote Magnetic Compass Indicator
28. Bank and Turn Indicator
29. Automatic Pilot Control Valve
30. Radio Altimeter Altitude Indicator
31. Radio Altimeter Altitude Limit Indicator Lamps
32. Forward Control Pedestal Dashlite
33. Instrument Panel Fluorescent Lamp
34. Fuel Pressure Indicator (Dual)
35. Fuel Quantity Gage
36. De-Icer Pressure Gage
37. Automatic Pilot Oil-Pressure Gage
38. Static Pressure Selector Valve
39. Landing-Gear Warning Lamps
40. Door Open Warning Lamp
41. Fluorescent Lamps Switch

Figure 310 deleted in revision dated 20 April 1945

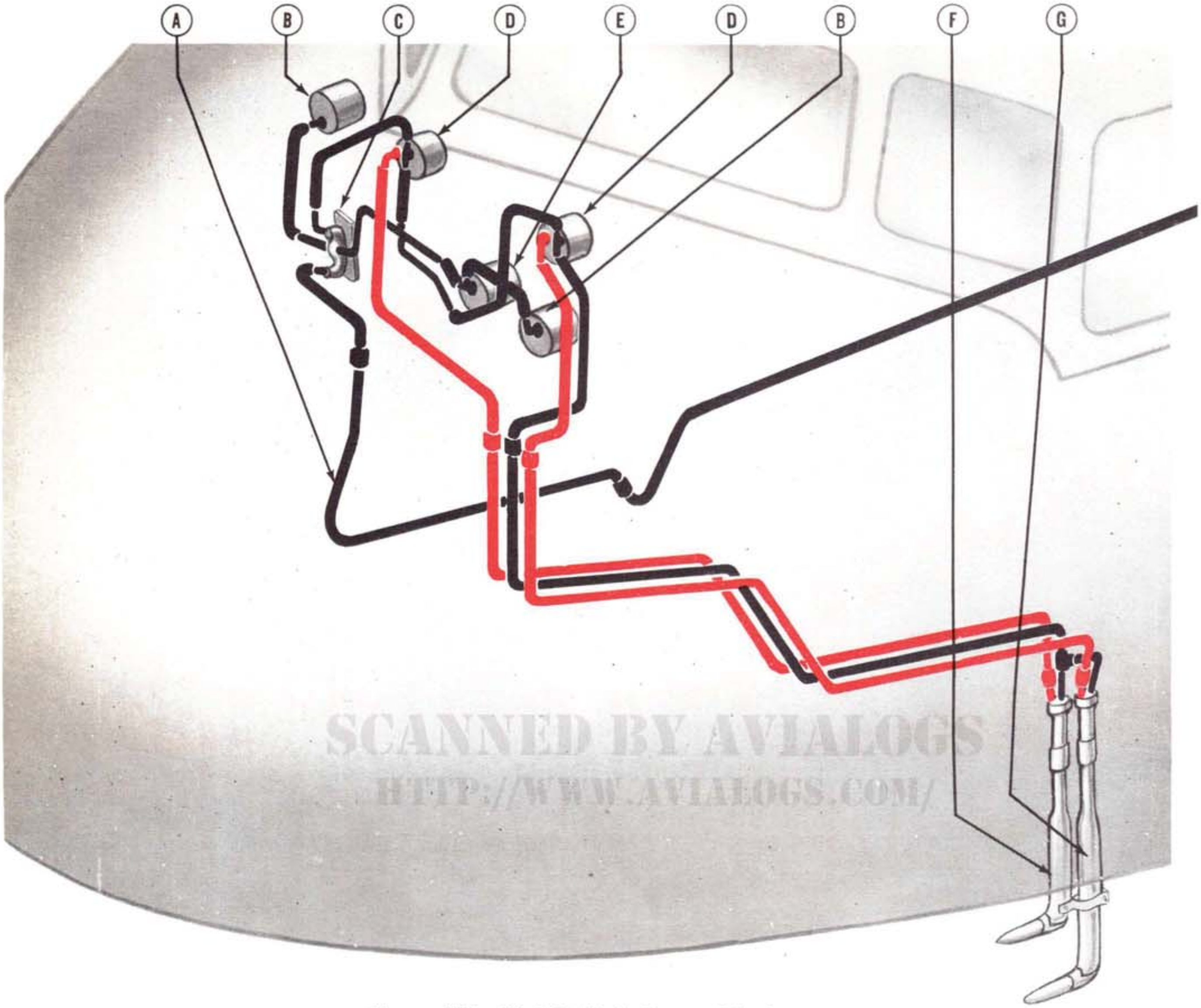


Figure 311—Pitot-Static Instrument System

(Douglas Dwg. 5110560, 514110, 5202422, and 5110514)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
A	(See section VIII, figure 631)	Alternate Static Line	Ref
B	(See instrument chart section IV, paragraph 11.*h.*)	Altimeter	2
C	2115896	Static Selector Valve	1
	AF811-ST-4D	Tee	1
	AF811-FT-4D	Nipple	2
D	(See instrument chart section IV, paragraph 11.*h.*)	Airspeed Indicator	2
E	(See instrument chart section IV, paragraph 11.*h.*)	Rate-of-Climb Indicator	1
F	314063	(Short) Pitot Tube Mast Assembly	1
	Includes		
	94-27874-8	Type D2 Pitot-Static Tube	1
	Attached with		
	AN4-47	Bolt	1
	AN4-42	Bolt	1
	AN310-4	Nut	1
G	3140968	(Long) Pitot Tube Mast Assembly	1
	Includes		
	94-27874-8	Type D2 Pitot-Static Tube	1

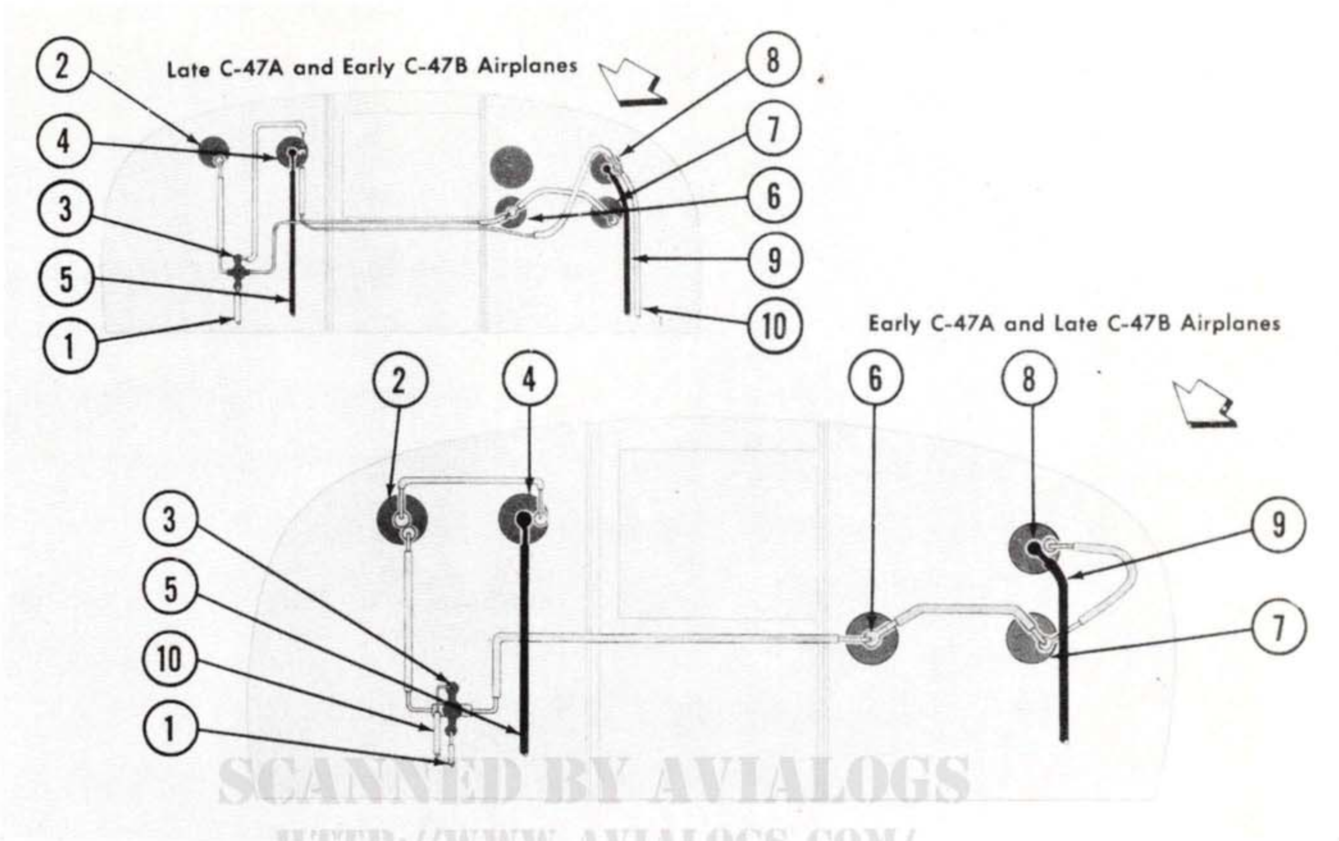

Late C-47A and Early C-47B Airplanes
2
4
3
5
1
8
7
6
9
10
Early C-47A and Late C-47B Airplanes
2
4
3
5
10
1
6
8
9
7

Figure 312—Pitot-Static Instrument Lines at Panel

1. Static Line (Alternate)
2. Altimeter
3. Static Selector Valve
4. Airspeed Indicator
5. Airspeed Line
6. Rate-of-Climb Indicator
7. Altimeter
8. Airspeed Indicator
9. Airspeed Line
10. Pitot Static Line

5. Slide the transfer film face up from the paper backing on to the exact position on the coat of varnish previously applied to the instrument surface.

6. Work out all air bubbles and excess water by using an edge of the card as a squeegee. Any varnish applied on the area greater than that which is desired may be removed with naphtha within ½ hour after application.

7. Allow to air-dry 30 minutes, then paint over the marker with a coat of varnish, decalcomania adhesive, AAF Specification No. 14123.

8. Allow to dry for 12 hours before touching.

(4) INSTALLATION.—To install the instrument panel, reverse the removal procedure.

c. PITOT-STATIC INSTRUMENTS AND EQUIPMENT. *(See figure 311.)*

(1) DESCRIPTION.—Pitot-static instruments and equipment installed on the airplane consist of two airspeed indicators, two altimeters, and one rate-of-climb indicator, all installed on the main instrument panel, two pitot-static tubes mounted on masts on the under side of the fuselage beneath the pilots' compartment, a static selector valve, and the connecting lines. The pitot-static tubes provide separate sources of pressure for each airspeed indicator. Static pressures from the two tubes are combined into a single source before they reach the instrument panel. The static selector valve is connected to this source of static pressure and also to an alternate static line which runs to the left aft gasoline container bay. On late C-47A and early C-47B airplanes, the alternate line provides a source of emergency static pressure for the altimeters and rate-of-climb indicator in the event that the pitot-static tube source should fail. On early C-47A and late C-47B airplanes, the alternate line provides an emergency source for both airspeed indicators as well as for both altimeters and rate-of-climb indicator in case of failure of the pitot-static source line. The pitot-static tubes are protected from ice by electrical heaters which are built into the tubes. Refer to paragraph 14., this section, for the heater wiring diagrams.

(2) TEST BEFORE REMOVAL.

(a) PITOT - STATIC INSTRUMENTS. — Improper operation of a pitot-static instrument may be due to (1) a faulty mechanism, (2) a leaking case, (3)

a leaking line or connection, or (4) foreign material in the pitot-static tubes or connecting lines.

(b) If the pointers of the air-speed indicators, the altimeters or the rate-of-climb indicator fail to respond, the source of the trouble frequently may be traced to a stoppage in the pitot-static tubes or the connecting lines. Disconnect the instruments involved and clean the lines and tubes by applying air pressure at the panel ends of the lines. If this fails to overcome the trouble, install a new instrument.

(c) If the pointers of the air-speed indicators and the rate-of-climb indicator oscillate, or if the altimeter reading is too high, the source of the trouble frequently may be traced to leakage of air in the instrument cases or the connecting lines. If tests show that an instrument case is leaking, remove the instrument and install a new one. If tests show that the instrument itself functions properly, test the lines and connections for leaks.

CAUTION

These tests should be made only by persons familiar with the delicate nature of the instruments. Test pressures must be applied and released slowly and gently to avoid damaging the instruments.

1. AIR-SPEED INDICATOR CASE LEAK TEST.

a. Disconnect the static line as close to the indicator as possible, and attach a rubber tubing to the instrument end. (See figure 312.)

b. Put the other end of the tubing in the mouth and softly take in breath until the pointer reaches 200 mph. Then pinch off the tube.

c. If the pointer descends faster than 5 mph, a leak in the indicator case is indicated, and the indicator must be replaced. If no case leak is indicated, test the connecting lines for leaks.

2. PITOT PRESSURE (AIR-SPEED) LINE LEAK TEST.

a. Seal the pitot pressure drain holes in the pitot-static tube with masking tape.

b. Attach a rubber hose to the pitot pressure (air-speed) opening at the end of the tube, making sure that the connection is airtight.

c. Blow GENTLY into the tube until the air-speed indicator is caused to read 150 mph. Then pinch off the source of pressure.

CAUTION

Do not apply suction to the pitot-pressure (air-speed) opening of the pitot-static tube.

d. During a 1-minute period the indicator pointer should not change appreciably from the 150-mph reading. The indicator case must be tapped with the fingers during the test to overcome the effects of friction on the pointer.

e. If the pointer indication varies by more than 10 mph, check the lines for cracks or faulty connections.

3. ALTIMETER CASE LEAK TEST.

a. Disconnect the line (static pressure) from the altimeter. (See figure 312.)

b. Connect a length of rubber tubing to the altimeter vent and by blowing gently, decrease the altitude indication by only 500 feet.

c. Pinch off the tube and watch the pointer for 10 seconds. Tap the indicator case to eliminate friction. The indication should not change more than 20 feet.

d. If the change is more than 20 feet during the 10-second period, a case leak is indicated and the altimeter must be replaced.

4. RATE-OF-CLIMB INDICATOR CASE LEAK TEST.

a. Set the indicator pointer to "ZERO" by means of the adjusting knob on the face of the instrument.

b. Disconnect the static line from the instrument and attach a rubber tubing to the inlet on the instrument case.

c. GENTLY and SLOWLY apply a suction which will cause the pointer to read 2,000 feet per minute ascent, then pinch the tube. The pointer then should return to "ZERO" and stay there as long as the tube is pinched off.

d. If the pointer rotates past "ZERO," an air leak in the instrument is indicated and another instrument should be installed. Be sure to tap the case while making the test to overcome friction in the pointer shaft.

5. STATIC PRESSURE LINE LEAK TEST.

a. Make certain that the static selector valve on the instrument panel is turned to the pitot-static tube source.

b. Set the altimeter pointer to "ZERO."

c. Connect a mild source of suction to the static opening of either pitot-static tube. (A rubber tube may be used by splitting one end and binding it to the pitot-static tube.)

d. Close the static openings in the other pitot-static tube.

e. Slowly apply SUCTION to the static line until the altimeter pointers indicate 1,000 feet.

f. Pinch off the source of pressure, and tap the instrument case. In 1 minute the altimeter pointers should not change their positions by more than 150 feet.

g. If the change in the position of the pointers exceeds 150 feet, check the lines for cracks or loose connections.

(3) REMOVAL.

(a) PITOT-STATIC INSTRUMENTS.—The instruments may be removed individually from the front of the instrument panel for replacement, adjustment, or repair by removing the four screws which hold each instrument in place, pulling the instrument out of the panel, and detaching the connecting lines. If more than one instrument is being removed, label the lines to facilitate replacement of the instruments.

(b) PITOT-STATIC TUBE.

1. Remove the four screws which attach the tube head to the mast.

2. Pull the tube out of the mast. It may be necessary to untie binding from lines and wires at the top of the mast.

3. Disconnect the pressure and static lines and the heater wires.

(c) PITOT-TUBE MASTS.

1. Remove the cover plates from the fuselage forward and aft of the masts. Also remove the forward cover from the left-hand lines tunnel.

2. Disconnect the two radio antennas clamped to the masts.

3. Remove the clamp which locks the two masts together.

4. Remove the long bolt which passes through both masts just below the fuselage skin.

5. Working through the access openings, remove the long bolt and the spacers from the masts inside the fuselage.

6. Disconnect the four lines from the top of the masts, and remove the strip of Koroseal which binds the four lines together.

7. Disconnect the electrical wiring at the disconnect located in the left-hand lines tunnel. Also remove the three clamps which secure the wires in the fuselage.

8. Pull downward on the masts, freeing them from the supporting brackets. Avoid scratching the attached lines.

(d) PITOT-STATIC LINES.—The lines connecting the pitot-static tubes to the pitot-static instruments may be removed by unscrewing the fittings at the ends of the lines and disengaging the attaching clips or clamps. The ends of the lines must be capped to exclude foreign material.

Note

With 12-volt electrical systems only, if pitot-static tubes, part No. 3200-1S, fail to de-ice properly or otherwise become unserviceable, they will be replaced with type C-8 pitot-static tubes, part No. 373D-01, available from class 05-C, Air Force Stock. (FSSC No. 88-T-3303 available from Navy Aviation Supply Office, Philadelphia, Pa.)

(4) MAINTENANCE REPAIR OR REPLACEMENT.

(a) PITOT-STATIC INSTRUMENTS.—Leaks in the cases of pitot-static instruments usually are the cause of undesirable pointer oscillation and errors in indication. Instruments which are functioning improperly should be tested for leaks by an instrument specialist before they are removed from the panel. If an instrument is found to be defective, it shall be replaced. If the instrument is accurate, the difficulty may be traced to leaking or clogged lines, or misalignment or clogging of the pitot-static tubes.

(b) PITOT-STATIC TUBES.

1. A damaged pitot-static tube, or a tube with a burned out heating element shall be replaced.

2. The pitot-static tubes must be kept clean at all times. When the airplane is not in operation, the tubes must be covered to protect them from dust, dirt, oil, and other foreign particles. The cover shall consist of a cloth, canvas, or leather sack and streamer, and shall be fabricated locally.

3. To clean dirt, moisture, or other foreign material from the pitot-static tubes, disconnect the lines from the altimeter, air-speed indicators, rate-of-climb indicator, and static selector valve at the disconnect manifold forward of the instrument panel, and apply suitable air pressure at the panel ends of the lines.

(c) PITOT-STATIC LINES.—Replace lines which are deformed or deeply scratched. For lines manufacturing information, refer to section VIII.

(5) INSTALLATION.—To install the pitot-static instruments and equipment, reverse the removal procedure. Apply a light coat of thread lubricant to the lines before connecting them. Check the condition of the flexible hoses and replace them if they have hardened or deteriorated.

d. VACUUM-OPERATED INSTRUMENTS AND EQUIPMENT. *(See figure 313.)*

(1) DESCRIPTION.—The vacuum-operated instruments installed on the C-47 airplanes consist of: a gyro horizon indicator (AN 5736-1), a directional gyro indicator (AN 5735-1), which is installed on some airplanes, a turn and bank indicator (AN 5820-1 or Type A-11) and the bank and climb control unit and the directional gyro control unit for the automatic pilot. The equipment consists of two engine pumps, two vacuum relief valves, two flapper-type check valves, a vacuum manifold, two air filters, a vacuum restrictor for the turn and bank indicator, and the connecting lines. On C-47B airplanes, there is a vacuum restrictor for the gyro horizon indicator and the directional gyro indicator. For maintenance information on the automatic pilot flight instruments refer to paragraph 11.*g.*, this section.

(2) REMOVAL.

(a) VACUUM-OPERATED INSTRUMENTS.

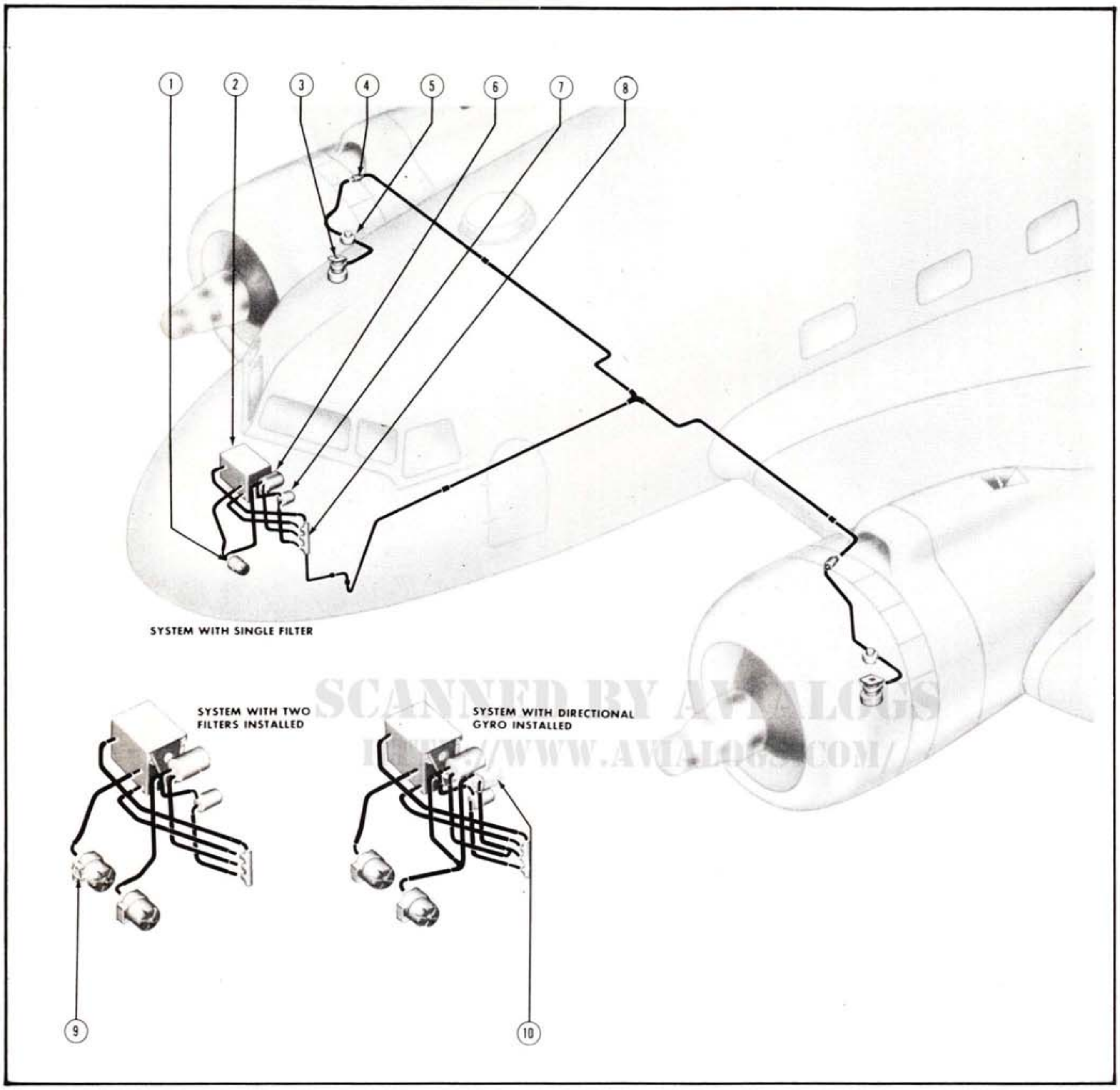

1
2
3
4
5
6
7
8
SYSTEM WITH SINGLE FILTER
SYSTEM WITH TWO FILTERS INSTALLED
SYSTEM WITH DIRECTIONAL GYRO INSTALLED
9
10

Figure 313—Vacuum System for Instruments and Automatic Pilot

1. Vacuum Air Filter
2. Automatic Pilot Mounting Unit
3. Vacuum Pump
4. Eclipse Check Valve
5. Eclipse Vacuum Relief Valve
6. Gyro Horizon Indicator
7. Turn and Bank Indicator
8. Vacuum Instrument Manifold
9. Vacuum Air Filter
10. Directional Gyro

—The instruments may be removed individually from the panel for adjustment, repair, or replacement by removing the four screws which secure each instrument in place and detaching the connecting lines.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) VACUUM-OPERATED INSTRUMENTS. —Damaged or defective vacuum instruments shall be replaced. Improper operation of the gyro instruments usually is caused by excessive vibration or an improper supply of vacuum. Check these possibilities before removing the instrument from the airplane. The following tests may be used:

1. BANK AND TURN INDICATOR.

a. Insufficient vacuum or excessive vacuum will cause faulty pointer action during a properly

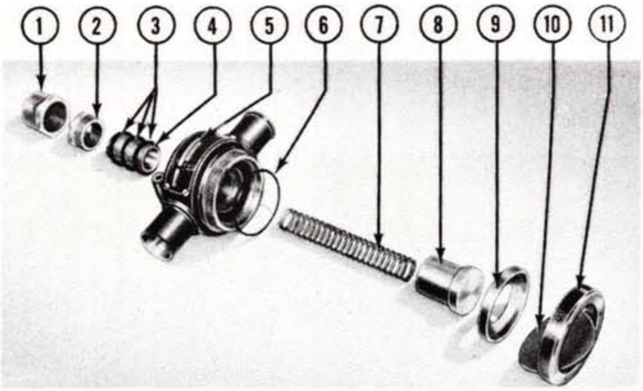


Figure 314—Vacuum System Relief Valve

1. Cap
2. Lock Nut
3. Washers
4. Adjustment Screw (Slotted for Screw Driver)
5. Case
6. Washer
7. Spring
8. Valve
9. Valve Seat
10. Screen
11. Retaining Ring

banked 180° standard turn.

b. If the pointer indication is too slow or too fast, check the vacuum at the manifold source and if the vacuum is incorrect, adjust the suction relief valves.

c. If the bank and turn indicator gives erroneous indication after the above steps are followed, remove the instrument and replace it with a calibrated, bench-tested instrument.

d. On late C-47B airplanes, the vacuum source to the turn and bank indicator is routed through the gyro horizon indicator. The source is held constant by a restrictor valve in the manifold assembly.

2. GYRO HORIZON INDICATOR AND DIRECTIONAL GYRO INDICATOR.

a. Check the vacuum supply to the gyro horizon and directional gyro indicators by observing the suction gage on the face of the bank and climb control box. The vacuum reading should be from 3.75 to 4.25 inch Hg. If the vacuum reading is not between these limits, adjust the vacuum relief valves, located on the aft side of each engine, to obtain the proper vacuum.

b. If the vacuum setting cannot be obtained by adjusting the relief valves, check the air filters and replace filter elements if they are dirty.

c. If vacuum reading is still low after new filter elements are added, check the lines for possible restrictions, sharp bends, leaks, or collapsed flexible hose. If lines are free, check vacuum being supplied to the flight indicators and if this vacuum supply is correct, remove and replace the bank and climb control unit.

d. If the line check indicates insufficient vacuum, check the engine pumps for possible pump failure and relief valve for possible malfunctioning and replace defective units.

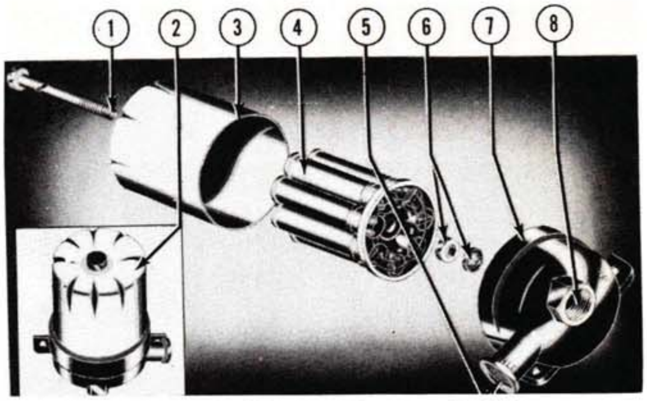


Figure 315—Vacuum System Air Filter

1. Disassembly Bolt
2. AN5822-1 Air Filter
3. Filter Case
4. Filter Elements
5. Inlet Screen
6. Nut and Lock Nut
7. Filter Head
8. Port to Instruments

e. Periodical checks should be made for moisture condensation, corrosion, and low spots or moisture traps in the vacuum lines.

(b) AIR FILTER.

1. Damaged or defective air filters shall be replaced. Cleaning of the air filter or replacement of the filtering elements normally is required after 25 hours of operation. When the airplane is flown in areas of low, dense atmospheric conditions, desert areas or is subject to radical quick temperature changes, the filters should be checked at specified intervals.

2. To disassemble and clean the filter elements, proceed as follows:

a. Disconnect the flexible hose from the filter outlet.

b. Cap the hose.

c. Loosen the bolt on the bottom of the filter and remove the filter head.

d. Remove the lock nut and nut from the bolt and pull out the filter elements.

e. Slide off the cylindrical diffusing screen which covers the filter elements.

f. Apply low-pressure compressed air to the open ends of the filter elements to loosen dirt deposits. Also direct the air along the filaments from each end. Do not apply the air pressure at right angles to the filter.

(c) ENGINE-DRIVEN VACUUM PUMPS.—Refer to Paragraph 19.*b.*(1)*(b),* this section.

(d) SUCTION RELIEF VALVES. — Replace worn or damaged suction relief valves.

(e) VACUUM MANIFOLD ASSEMBLY.—A damaged or defective vacuum manifold assembly shall be replaced.

(f) CHECK VALVES.—Replace worn or defective check valves.

(4) INSTALLATION.—To install the vacuum-operated instruments, reverse the removal procedure Apply a light coat of thread lubricant to the threads before connecting the lines to the instruments. Check the condition of the flexible connecting hoses and replace them if they have collapsed or deteriorated.

(5) ADJUSTMENTS.

(a) VACUUM-OPERATED INSTRUMENTS.—No adjustments shall be made on the vacuum-operated instruments other than those which can be accomplished by regulating the suction relief valves which control the vacuum supply.

(b) SUCTION RELIEF VALVES.—To increase the suction supplied to the vacuum-operated instruments loosen the jam nuts on the suction relief valves and turn the adjusting screw *counterclockwise.* To decrease the suction, turn the screw *clockwise.* The relief valve should be adjusted to supply a vacuum of 3.75 to 4.25 inches Hg to the instruments.

(6) TEST AFTER INSTALLATION.

(a) VACUUM-OPERATED INSTRUMENTS.

1. TURN AND BANK INDICATORS.—The indicator pointer must be at "ZERO," ±1/64 inch, when the gyro rotor is spinning. When the airplane is in the normal horizontal position, the ball in the indicator must rest at "ZERO" within ±1/32 inch. Tap the instrument rim gently to eliminate friction effects.

2. GYRO HORIZON INDICATOR AND DIRECTIONAL GYRO.—Defective flight indicators can be detected by observing the following: rotors spilling over, "growling" or clanking noises emitting from the instrument cases, directional gyro rotor card spinning or the pointer sticking or jerking, gyro horizon bar rising or falling without cause. Any of these indications that are apparent with proper vacuum on the system will necessitate removal and replacement of the gyro instruments.

e. PRESSURE TYPE INSTRUMENTS.

(1) OIL PRESSURE REMOTE INDICATING SYSTEM.

(a) DESCRIPTION.—The remote indicating system installed on some airplanes consists of two diaphragm-type transmitters, a dual oil-pressure indicator, and the connecting lines. One transmitter is located on the accessory case of each engine. One flexible line extends from the bottom of each transmitter to the engine oil case. When the engines are operating, these lines are filled with engine oil. Flexible lines extend from the top of each transmitter to the fire wall. From the fire wall, copper piping extends to the indicator. These lines are completely filled with a low viscosity compass fluid. The remote oil-pressure indicating system insures accurate instrument readings at temperatures as low as —54°C (—65°F).

(b) MAINTENANCE REPAIR OR REPLACEMENT.

1. INDICATION LOW OR ABSENT.

a. If the oil-pressure indication is low or absent, the trouble ordinarily may be traced to compass fluid leaks in the connecting lines or to a faulty indicator. Make a careful visual inspection of the lines and connections. If a leaking connection is discovered, drain the remaining compass fluid from the line. Take the leaky connection apart and inspect the flaring on the tube for cracks, distortions, or dirt. Correct all cracks or distortions immediately.

b. If there is no leakage visible to the eye, make the following air pressure test for gradual leakage in the lines or indicator case:

(1) Drain the compass fluid from the lines.

(2) With the oil-pressure indicator properly connected, disconnect the instrument line at the transmitter.

(3) Install a suitable air valve at the transmitter end of the instrument line. (A Schrader valve is recommended.)

(4) Attach to the valve an air pressure source equipped with a pressure regulator.

(5) Apply an air pressure of 160 pounds per square inch, as indicated on the oil-pressure indicator. Do not exceed 160 pounds.

(6) Maintain the air pressure for 1 hour. If the indicator shows a pressure drop, check all connections for leaks, using a brush and soap suds.

c. If no leaks can be found in the lines, it may be assumed that the oil-pressure indicator is defective. Install a new indicator and refill the lines.

2. SLUGGISH INDICATION.—If the indicator pointer responds very slowly to the engine oil pressure, the difficulty ordinarily may be traced to a broken diaphragm in the transmitter. Damage of this kind will allow the engine oil to enter the compass fluid lines. To overcome the difficulty it will be necessary to drain the compass fluid and oil from the indicator end of the line and install a new transmitter. Then refill the system with compass fluid as described following.

3. REFILLING COMPASS FLUID LINES. *(See figure 317.)*

a. Use aircraft compass fluid, Specification No. MIL-C-5020, in the system. Use a portable filling gun or the master gage unit from the field instrument set. Make certain that no air is forced into the the lines with the compass fluid. The indicating system will not operate accurately unless it is COMPLETELY free of air bubbles.

b. Center the diaphragm within the transmitter by loosening the lock nut which secures the thumbscrew on the front of the instrument, and pushing in on the thumbscrew until the pressure plate rests on the diaphragm. Then turn the thumbscrew clockwise until the diaphragm is firmly supported.

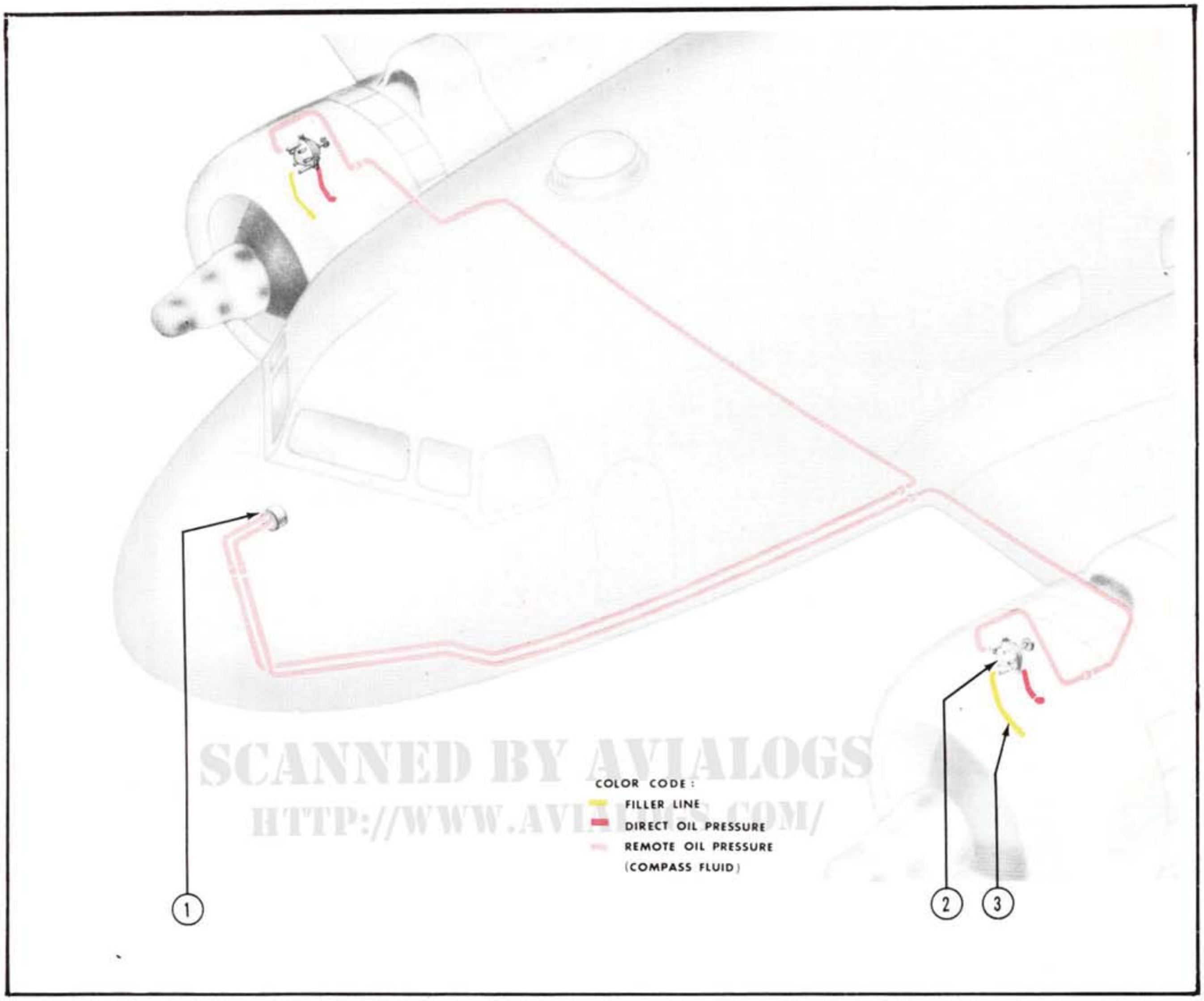


Figure 316—Oil-Pressure Remote Indication System

(Douglas Dwgs. 5141803 and 5203252)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	AN5772-2	Oil-Pressure Indicator (Dual)	1
2	Type A-1	Oil-Pressure Transmitter	2
	AN822-2D	Elbow	2
3	5112314-38	System Filler Line (Rigid)	2

Note:
Refer to figure 632, section VIII, for lines manufacturing information and fitting part numbers.

CAUTION

Damage to the transmitter will result if the diaphragm is not centered before filling the system.

c. Remove the cap from the filling line (figure 284) which extends downward from the transmitter and connect the filling gun or master gage unit to the check valve attached to the end of the filling line.

d. Remove the cap from the check valve at the instrument and connect a discharge line, venting it into a suitable vessel.

e. Using a maximum pressure of 25 pounds per square inch, slowly force the compass fluid into the system. Continue filling until all air is removed from the system and air bubbles cease to appear at the immersed end of the bleed line.

f. Remove the filling equipment and the discharge line and replace the caps.

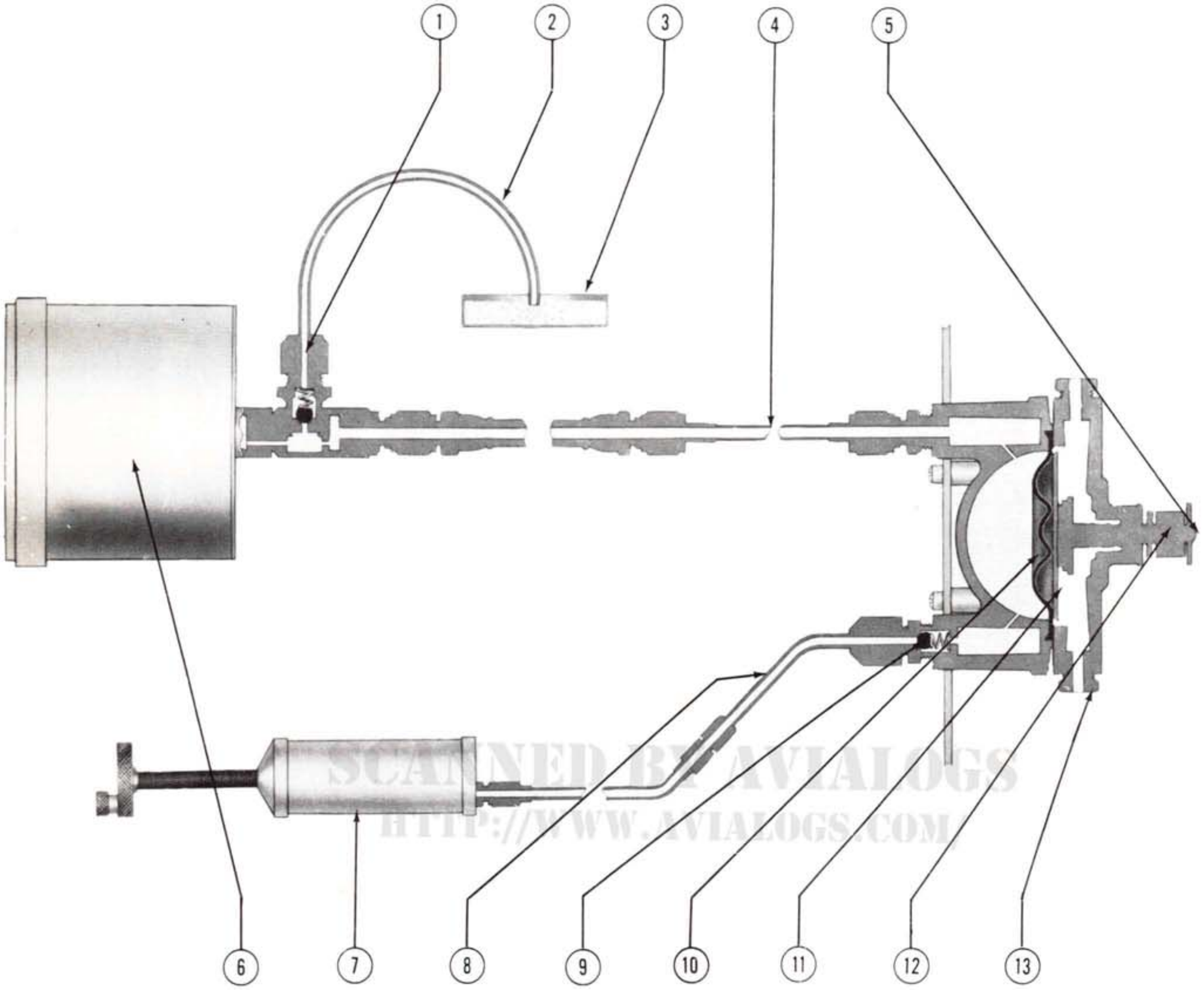


Figure 317—Filling Procedure for Oil-Pressure Remote Indication Lines

1. Check Valve
2. Bleed Line
3. Discharge Vessel
4. System Tubing
5. Thumb Screw
6. Oil-Pressure Indicator
7. Filler Gun
8. Filler Line
9. Check Valve (on the C-47A airplane this valve is installed on the end of the filler line)
10. Transmitter Diaphragm
11. Pressure Plate
12. Lock Nut
13. Engine Oil Inlet

g. Loosen the thumbscrew on the transmitter, and pull it out with the fingers as far as it will go. Then tighten the thumbscrew lock nut.

h. With the flexible line which leads to the engine properly connected, the system is ready for operation.

i. Check the indicator for "ZERO" setting. If there is a pressure indication on the indicator, with no pressure being applied at the transmitter, it will be necessary to remove and replace the instrument with a properly calibrated, bench tested indicator.

(2) OIL PRESSURE DIRECT READING SYSTEM.

(a) DESCRIPTION.—The oil-pressure direct reading system installed on some airplanes consists of a dual oil-pressure indicator AN 5772-2 (was type B-10), a restricted fitting, located near the engine oil case and the connecting lines.

(b) MAINTENANCE REPAIR OR REPLACEMENT.

1. INDICATION LOW OR ABSENT.

a. If the oil-pressure indication is low or absent, look for line leaks or a collapsed flex hose.

b. Disconnect the lines at the instrument panel and at the engine and flush the lines with hydraulic fluid.

c. Check the restricted fitting to see that the opening is clear.

d. If indication is still low, replace the oil-pressure indicator.

2. REFILLING LINES. Refill the lines by removing the fitting at the indicator and pumping hydraulic fluid, Specification No. MIL-O-5606 into the lines. As soon as bubbles appear at the engine end of the lines, the bubbles and oil should be allowed to drain off, until the lines are completely free of all air bubbles. Attach the restricted fitting to the engine oil case.

(3) MANIFOLD PRESSURE GAGE.—One dual, direct-reading manifold pressure gage (AN 5770-2 or Type D-11) is mounted on the instrument panel. The manifold pressure system (figure 222) is used to measure the pressure at which the fuel air mixture enters the engine intake system. The direct reading dual gage (figure 310) measures the amount of pressure in inches of mercury. The line system connects the gage to the blower case on each engine. (See figure 222.) A selector valve, located on the back of the instrument panel, and controlled by a single handle control on the instrument panel, provides for bleeding of moisture from both the instrument and engine lines during engine warm-up. This selector valve also provides for reversing the reading of the dual gage as a check to determine whether or not a faulty gage is causing an incorrect reading. For example, with both engines operating, if the gage hand marked "L" for "left engine" is showing a low reading, the selector valve handle may be moved to "OPPOSITE ENGINE." If the "L" gage hand still shows a low reading it is an indication that the manifold pressure gage is faulty. However, if the "L" gage hand now shows a normal reading and the "R" gage hand drops to a low reading, it is an indication that the manifold pressure for the left engine is low.

(4) FUEL PRESSURE GAGE.—One dual, direct reading fuel pressure gage (AN 5772-1 or Type C-13) is installed on the right hand side of the instrument panel. It is a Bourdon-tube type instrument and registers from 0 to 25 psi. For further information on fuel pressure refer to paragraph 10.*g.*, section IV.

(5) DE-ICING PRESSURE GAGE.—Refer to paragraph 19.*b.*(1)*(b)* section IV.

(6) CLOCK.

(a) DESCRIPTION.—One clock (AN-5743-1) is installed on the left-hand side of the instrument panel. It has an eight-day stem wind movement with a sweep second hand and is not affected by magnetism either permanent or induced.

(b) REMOVAL.—Remove the two mounting screws and remove the clock from the airplane.

(7) ASTRO COMPASS.

(a) DESCRIPTION.—The astro compass (Army Type A-1) is used to provide the navigator with a true heading of the aircraft, and to swing and correct the magnetic compass reading during flight. The instrument contains scales for setting latitude, longitude, and date set. The instrument is rotated until a chosen star is sighted. The true bearing of the airplane is read on a resultant scale. The astro compass is mounted on a base, which is permanently installed in the airplane in such a position as to properly align the astro compass with the airplane axis. The design of the mount permits removal of the astro compass, which is kept in a transit case when not in use.

f. COMPASSES.

(1) DESCRIPTION.

(a) PILOTS' COMPASSES.—On some airplanes a single, direct reading magnetic compass is installed for the use of the pilots. The compass is supported by rubber bungees in the "V" of the windshield. On other airplanes the direct reading compass is supplemented by a remote magnetic compass indicator AN 5730-2A installed on the instrument panel. The indicator is installed in conjunction with a remote magnetic compass transmitter located in the right outer wing panel. (See figure 324.) The remote compass indicator is electrically actuated. For more information concerning this unit and the transmitter, refer to paragraph 14.*j.* (9), this section.

(b) NAVIGATOR'S COMPASSES.—On some airplanes the navigator's compartment is equipped with a direct reading aperiodic compass. On other airplanes the aperiodic compass has been replaced by a remote magnetic compass indicator AN 5730-2A connected electrically to a remote magnetic compass transmitter (figure 324) installed in the right outer wing panel. (This transmitter serves both the pilots' and navigator's remote indicators.) For more information concerning this unit and the transmitter, refer to paragraph 14.*j.* (9), this section. On some airplanes there is a mount for the astro compass (Army Type A-1) installed directly under the astrodome. This mount is designed to permit removal of the astro compass when not in use.

(2) ADJUSTMENT.—The compasses must be swung and compensated for deviations from the actual magnetic heading of the airplane at least once every 3 months. To insure accuracy the compasses also should be swung and compensated before any long flight, when ferrous material (iron, steel, etc.) is stowed in the cargo compartment prior to a flight in which the compass will be required, when new electrical or radio equipment is installed in the vicinity of the compasses, and following rough landings. While the types of compasses used on the airplane vary, the procedure for swinging and compensating them is practically the same. All compasses may be adjusted in 2½ swings of the airplane around the principal headings of the compass. The aperiodic compass, if installed, is affected by adjacent electrical equipment and as a result corrections must be made with the navigator's compartment lights and the dome lights "ON," with

	Compensating Swing			Residual Swing		Aircraft Comp. ____	Date ____	
	Actual Head (M)	Aircraft Comp.	Dev'n	Actual Head (M)	Aircraft Comp.	C to M		M to C
N 000	005	001	+4	002½	001	+1½	000	−1½
NE 045				040	043	−3	045	+3
E 090	087	090	−3	095	094	+1	090	−1
SE 135				136	134	+2	135	−2
S 180	176	180½	−4½	185	184	+1	180	−1
SW 225				222	225	−3	225	+3
W 270	265	273	−8	275	276	−1	270	+1
NW315				317	316	+1	315	−1
	(1)	(2)	(1)-(2)	(3)	(4)	(3)−(4)		(4)−(3)

If swinging compass used ahead of aircraft add or subtract 180 degrees.

$$\text{Coeff. } C = \frac{N-S}{2} = \frac{(+4)-(-4\frac{1}{2})}{2} = +\frac{8\frac{1}{2}}{2} = +4\frac{1}{4} \text{ OR } +4$$

$$\text{Coeff. } B = \frac{E-W}{2} = \frac{(-3)-(-8)}{2} = +\frac{5}{2} = +2\frac{1}{2}$$

$$\text{Coeff. } A = \frac{N+E+S+W}{4} = \frac{(+4)+(-3)+(-4\frac{1}{2})+(-8)}{4} = -\frac{11\frac{1}{2}}{4} = -3$$

16—29598-1

Figure 318—Typical Compass Correction Card

both of the generator main line switches "OFF" and with all radio equipment excepting the command receiver "OFF." The remote indicating magnetic compass transmitter installed on some airplanes and the pilots' direct reading compass are not affected appreciably by equipment installed on the airplane and there are no special conditions under which the corrections must be made other than the leveling of the transmitter itself when the swing is made with the airplane in the "TAIL DOWN" position. It is recommended that the swing be made with engines operating at 1,000 rpm and with the main line generator switches "ON." This will insure maximum sensitivity in the electrically operated indicators. The following correction procedure is particularly intended for use in the field where the only equipment available consists of a swinging compass and a nonmagnetic screw driver. A plumb line also is required but this may be improvised with a weight and cord as necessary.

(a) GROUND SWING.

1. Remove all metal objects from clothing.

2. All magnetic equipment in the aircraft shall be secured in the position occupied in normal flight. All controls and levers shall be placed in their normal position.

3. Select a smooth site which is remote from other airplanes, machinery, wires, building, or other influences which might distort the earth's magnetic field. If necessary, check suitability of the area with the hand-held swinging compass by taking several bearings from random positions on one object several miles distant. If all bearings are the same, the area is suitable.

4. Any equipment which is used to lift the tail of the airplane to a level flight position shall preferably be made entirely of non-magnetic material. If any magnetic parts are used, the apparatus shall be tested for its effect on the compass by being moved about the compass in a circle whose radius is equal to the normal distance between it and the compass. The changes in compass reading due to such movement shall not exceed ¼ degree.

5. Neutralize the compasses on the airplane, either by lining up the dots at the compensating screws or by removing the compensating units. Use a non-magnetic screw driver.

6. If remote indicating magnetic compasses are installed, shift the transmitter in the right outer wing to a horizontal position by loosening the thumbscrew on the forward side of the mount and lining up the transmitter with a level. Neutralize the transmitter by lining up the dots on the east-west and north-south adjustment screws with the dots on the case. Use a non-magnetic screw driver.

7. Obtain a swinging compass with a reversed polarity so that readings can be taken from in front of the airplane without the necessity of adding or subtracting 180 degrees. (Compasses on which the poles have been reversed are painted a bright red.)

8. To check for serviceability prior to swinging, the pilots' compass shall be examined to ascertain that the liquid is clear and that no air bubble shows. The card shall be level and when deflected a few degrees on each side of equilibrium position, shall return to its original position within the friction error tolerance for that compass. To determine serviceability of a remote indicating magnetic compass the transmitter magnets shall be deflected. As the transmitter returns to equilibrium, the indicator shall return to its original position within the friction error for that compass.

9. Obtain pilots' compass correction cards (AN5803-1) from stock. (See figure 318.) (One will be required for each compass indicator on the airplane.) Supply these cards to personnel aboard the airplane with instructions to note down the actual heading of the airplane and the readings of the compass in the columns on the cards. On the first swing, readings will be taken only on the four cardinal magnetic headings —south, west, north, and east. The readings will be noted in the columns on the left side of the card.

10. The airplane shall be swung on the compass rose as follows:

a. The compensator shall be set to null effect. Loose magnet compensators shall be set to null effect by removing all loose magnets. Universal screw type compensators shall be set to null effect by turning both adjusting screws until the dots on the screws are matched with the dots on the compensator case.

b. The airplane shall be placed on a *south* magnetic heading by the most suitable method and the compass reading noted. The compass deviation on the south heading shall be determined.

c. The airplane shall be placed on a *west* magnetic heading and the compass reading noted. The deviation on the west heading shall be determined.

d. The airplane shall be placed on a *north* magnetic heading and the compass reading noted. The deviation on the north heading shall be determined and the coefficient "C" computed.

$$\text{Coefficient C} = \frac{N - S}{2}$$

With the airplane still on the north heading, the north-south compensator shall be so adjusted as to cause the compass reading to change by an amount equal in magnitude and in algebraic sign to the coefficient "C." If the compensator is of the loose magnet type, the adjustment shall be made by inserting the proper magnets into the lateral (athwartship) chamber of the compensator. If the compensator is of the universal type, adjustment shall be made by turning the N-S compensator screw.

e. The airplane shall be placed on an *east* magnetic heading and the compass reading noted. The deviation on the east heading shall be determined and the coefficient "B" computed.

$$\text{Coefficient B} = \frac{E - W}{2}$$

With the airplane still on the east heading, the east-west compensator shall be so adjusted as to cause the compass reading to change by an amount equal in magnitude and in algebraic sign to the coefficient "B." Loose magnet compensator shall be adjusted by inserting the proper magnets into the longitudinal (fore and aft) chamber. Universal compensators shall be adjusted by turning the E-W compensator screw.

f. While the airplane is still on the east heading, the coefficient "A" shall be computed.

$$\text{Coefficient A} = \frac{N + E + S + W}{4}$$

Panel mounted compasses shall be compensated for coefficient "A" if its magnitude exceeds two degrees. Horizontally mounted compass transmitters shall be compensated for coefficient "A" if its magnitude exceeds one degree. For panel mounted compasses compensation shall be accomplished by realigning the instrument panel or by turning the face of the compass relative to the plane of the instrument panel by means of washers or spacers. For horizontally mounted compasses, including remote indicating magnetic compass transmitters, compensation of coefficient "A" shall be accomplished by loosening the mounting screws and rotating the compass by the required amount. Adjustment shall be such as to change the compass reading by amount equal in magnitude and in algebraic sign to coefficient "A."

g. After compensation, the airplane shall be swung for residual deviations on 8 symmetrical headings and the compass readings recorded on a compass correction card. The correction card shall be mounted on the instrument panel near the compass or remote compass indicator.

11. If a remote indicating magnetic compass transmitter is installed, restore it to the "FLIGHT" position by loosening the thumbscrew and lowering the transmitter to the mounting table.

12. Complete the forms by filling in the last two columns from the data obtained in the residual swing. The entries for the left column are obtained by subtracting column 4 from column 3 for each heading, as indicated under the (C to M) column. Entries for the right column (M to C) are obtained by subtracting column 3 from column 4. Complete the correction cards by supplying the information required on the back. Detach the compass cards and insert them in the compass card holders on the airplane. Place the remainder of the form in a permanent file.

COMPASS ROSE METHOD.

EXAMPLES OF CALCULATING COEFFICIENTS FOR COMPASSES HAVING MAGNETIC COMPENSATORS.—

It will be assumed that the compass to be swung is of the horizontal mounted type.

(1) Deviations with Compensator set to Null Effect.—

Magnetic Heading	Compass Reading	Deviations
South — 180	175-½	+4-½
West — 270	276	—6
North — 000	006-½	—6-½
East — 090	090	0

(2) Coefficient "C".—

$$C = \frac{(-6\frac{1}{2}) - (+4\frac{1}{2})}{2} = \frac{-11}{2} = -5\frac{1}{2}$$

With airplanes on north magnetic heading, adjust N-S compensator so that compass will read 001 degrees.

(3) Coefficient "B".—

$$B = \frac{(0) - (-6)}{2} = \frac{+6}{2} = +3$$

With airplane on east magnetic heading, adjust E-W compensator so that compass will read 093 degrees.

(4) Coefficient "A".—

$$A = \frac{(-6\frac{1}{2}) + (0) + (+4\frac{1}{2}) + (-6)}{4} = \frac{-8}{4} = -2$$

With airplane still on east magnetic heading realign compass so that it will read 091 degrees.

(b) AIR SWINGS.

1. CELESTIAL BEARINGS. — Air swinging by celestial bearings may be accomplished by use of either an astro compass or a pelorus.

a. ASTRO COMPASS METHOD. — The astro compass shall be readable and accurate to within one and one-half degrees. Suitable mountings shall be provided in the aircraft for the astro compass. Each mounting shall be installed in the airplane with the fore and aft line of the mounting parallel to the fore and aft axis of the airplane within ½ degree.

b. ALIGNMENT OF ASTRO COMPASS MOUNT IN AIRPLANE. — The airplane shall be placed on a known true heading on the ground, and the astro compass shall be leveled and set on the sun or on a distant object whose true bearing is known. If the bearing as found by the astro compass does not agree with the known bearing, the mounting shall be rotated by an amount sufficient to correct the error and reclamped.

c. GRAPH OF L.H.A. vs. G.C.T.—The following procedure shall be carried out in advance before an air swing is made. A celestial body shall be chosen whose altitude will be less than 45 degrees during the time and at the place of the swing. With the aid of the Air Almanac or by other suitable methods a graph shall be plotted of local hour angles against Greenwich civil time for the latitude and longitude of the point at which center of the selected flying area and for the period of time during which the air swing is to be carried out. The flying area shall be a circular region of radius not exceeding 10 miles.

d. METHOD OF ALIGNING AIRCRAFT. —Air swings shall be carried out in smooth air. Visibility shall be such that the airplane can be located with respect with the ground at all times. The airplane shall be flown by automatic pilot or by reference to a directional gyro over the area previously selected while the sights are being taken. With the airplane on the desired heading, the average reading of the compass for a 20 to 30 second period shall be estimated. At the same time the astro compass shall be read. The local hour angles set into the astro compass shall be determined from the graph of local hour angles against Greenwich civil time, in conjunction with a watch keeping Greenwich civil time. The true headings indicated by the astro compass shall be converted to magnetic headings by applying the local variation which may be taken from the latest local air map corrected for the date or from any suitable source.

e. PELORUS METHOD. — The pelorus shall be readable and accurate to within one degree. Suitable mounting bases shall be provided for the pelorus in the aircraft. Each mounting base shall be installed in the airplane with the fore and aft line of the mounting parallel to the fore and aft axis of the airplane within ½ degree.

f. ALIGNMENT OF PELORUS MOUNTINGS IN AIRPLANE.—The airplane shall be placed on a known true heading on the ground. The pelorus shall be set on the sun or a distant object whose true bearing is known. If the bearing as found by the pelorus does not agree with the known bearing, the mounting base shall be rotated by a sufficient amount or suitable correction shall be applied to all subsequent readings.

g. GRAPH OF AZIMUTH vs. TIME.—The following procedure shall be carried out in advance before an air swing is made. A celestial body shall be chosen whose altitude will be less than 45 degrees at the time and place of the swing. A graph shall be plotted or a table constructed showing the azimuth of the selected celestial body against time at the center of the selected flying area for the period of time during which the air swing is to be carried out. The values of azimuth for a number of points on the graph or the values of azimuth contained in the table may be determined by any suitably accurate method. The flying area shall be a circular region of radius not exceeding ten miles.

h. METHOD OF ALIGNING AIRCRAFT. —Air swings shall be carried out in smooth air. Visibility shall be such that the airplane can be located with respect to the ground at all times. The airplane shall be flown by an automatic pilot or by reference to a directional gyro over the area previously selected while sights are being taken. With the airplane on the desired heading the average reading of the compass for a 20 to 30 second period shall be estimated. At the same time the pelorus shall be read. The azimuth set into the pelorus shall be determined from the graph or table of azimuth against time. The true headings indicated by the pelorus shall be converted to magnetic headings by applying the local variation, which may be taken from the local air map corrected for date, or from any other suitable source.

2. TERRESTRIAL BEARINGS.

a. DRIFT SIGHT.—A drift sight of a type which provides a recticle containing parallel grid lines shall be used. The drift sight shall be installed in such a way that the grid lines are parallel to the fore-and-aft axis of the airplane when the instrument is adjusted for zero drift.

b. ALIGNMENT OF DRIFT SIGHT.—A string shall be stretched under the drift sight parallel to the fore-and-aft axis of the airplane. If the alignment is correct, the grid lines will be parallel to the string when the instrument is adjusted for zero drift. If the grid lines are not parallel to the string, the drift sight shall be realigned.

c. METHOD OF ALIGNING AIRCRAFT. —Air swings shall be carried out in smooth air. Visibility shall be such that the landmark is not obscured by clouds or haze at any time during the swing. A suitable reference landmark shall be used such as a straight railroad, highway, or pipe line whose magnetic direction is known. The airplane shall be flown by an automatic pilot or by reference to a directional gyro over the reference landmark and a line of the drift sight reticle shall be aligned parallel to the landmark. The average of the compass readings for a 20- to 30-second period shall be estimated. The airplane shall be on a straight level course during this time. The magnetic heading shall be determined by subtracting the bearing of the landmark relative to the airplane from the magnetic direction of the landmark.

d. PRELIMINARY PRECAUTIONS.— Prior to the swinging procedure the following precautions shall be observed.

(1) All magnetic equipment in the aircraft shall be secured in the position occupied in normal flight. All controls and levers shall be placed in their normal position.

(2) All observers who either read or are near the compasses during swinging shall possess no magnetic materials on their persons. These may include tools, pocket knives, mechanical pencils, metal wrist-watch bracelets, eyeglasses with magnetic frames, officer's caps, badges and shop buttons, head sets, etc.

(3) A non-magnetic screw driver shall be used for adjusting all universal compensators.

3. AIR SWING PROCEDURE.

a. The compensator shall be set to null effect as specified for swinging by the compass rose method.

b. The airplane shall be flown successively on compass headings of approximately 090, 180, 270, and 000 degrees (within five degrees) and the corresponding magnetic headings shall be determined by any of the methods specified for Air Swings. (Refer to Paragraph f(2)(b).)

c. The airplane shall be landed and coefficients "A", "B", and "C" shall be computed.

d. The airplane shall be aligned on an approximately north magnetic heading and the compensator shall be adjusted to compensate the coefficient "C" as described for the compass rose method. The alignment of the airplane, which shall be within five degrees, may be accomplished either by means of a compass rose or sighting compass, or by reference to the aircraft's compass itself, after making due allowance for the magnetic deviation. It is assumed that the deviation on the ground is substantially the same as that in the air. For example, if the deviation on the north is —3 degrees, the compass reading on a north magnetic heading is 003 degrees. The airplane shall therefore be placed on a compass heading of approximately 003 degrees.

e. By one of the methods described above, the airplane shall be aligned on an approximately east magnetic heading and the compensator shall be adjusted to compensate the coefficient "B" as described for the compass rose method.

g. AUTOMATIC PILOT. *(See figure 319.)*

(1) GENERAL.—The automatic pilot installed on the airplane provides automatic flight control when this feature is desired. The gyroscopic instruments which form a part of the automatic pilot are actuated by vacuum pressure supplied by either of two vacuum pumps mounted on the engines. The automatic pilot's "instructions" are executed by hydraulic fluid pressure provided by either one of two hydraulic fluid pumps mounted on the engines. The type A-3 (Sperry) automatic pilot is installed on some of the airplanes and the type A-3A-1 (Jack & Heintz) automatic pilot is installed on the others. The two types are essentially the same. However, on the Jack & Heintz automatic pilots, the speed control valves have been replaced by sensitivity dials. The principal parts of the automatic pilot system are: the bank-climb gyro control unit, the turn gyro control unit, the mount assembly, the speed control valve assembly (not used on the Jack & Heintz automatic pilot), the hydraulic servo unit, the hydraulic fluid pressure regulator, the hydraulic fluid pressure

gage, the hydraulic fluid filter, the hydraulic fluid drain trap, the exhaust check valve, the drain check valves, the follow-up cable assemblies, the automatic pilot engaging lever (operates the servo on-off valve), and the emergency shut-off valve. Other equipment in the airplane which also is involved in the operation of the automatic pilot consists of the hydraulic pumps and reservoir, discussed in paragraph 13., and the vacuum pumps, vacuum relief valves, and the air filter, discussed in paragraph 11.*d.*, this section.

(a) PRE-FLIGHT GROUND TEST. (INCLUDING AN AIR BLEEDING PROCEDURE.)

1. Make sure that the automatic pilot emergency shut-off valve on the hydraulic control panel is in the "ON" position.

2. Make sure that the automatic pilot engaging lever on the control pedestal is in the "OFF" position.

3. Check the fluid level in the hydraulic reservoir at the sight gage on the hydraulic control panel.

4. Operate the engines at approximately 1,000 rpm.

5. Check the vacuum pressure on the suction gage. This pressure should be between 3.75 and 4.25 inches Hg. The most desirable pressure is 4.0 inches Hg. If necessary adjust the vacuum relief valve.

6. Check the hydraulic fluid pressure on the gage. The reading should be 120 psi ± 10 psi. Pressure may be increased or decreased by removing the acorn nut on the hydraulic fluid pressure regulator and turning the adjustment screw.

7. Uncage the bank-climb gyro. Set the turn gyro to the desired heading and uncage.

8. Manually place the flight controls in the "NEUTRAL" position. (This places the servo pistons in "NEUTRAL" position in the cylinders.)

9. By means of the trimmer control knobs set the rudder follow-up card to match the turn gyro card; set the aileron follow-up index to match the bank index, and set the elevator follow-up index to match the elevator alignment index.

CAUTION

Do not align the elevator alignment index with the horizon bar as the relative movement between the elevator alignment index and the horizon bar is in opposite directions.

10. On the type A-3A-1 (Jack & Heintz) automatic pilot, set each air bleed sensitivity dial at the bottom of the mount assembly to position "3" or "AVERAGE." On the type A-3 (Sperry) automatic pilot, open the three speed control valves on the lower left-hand side of the main instrument panel to position "6."

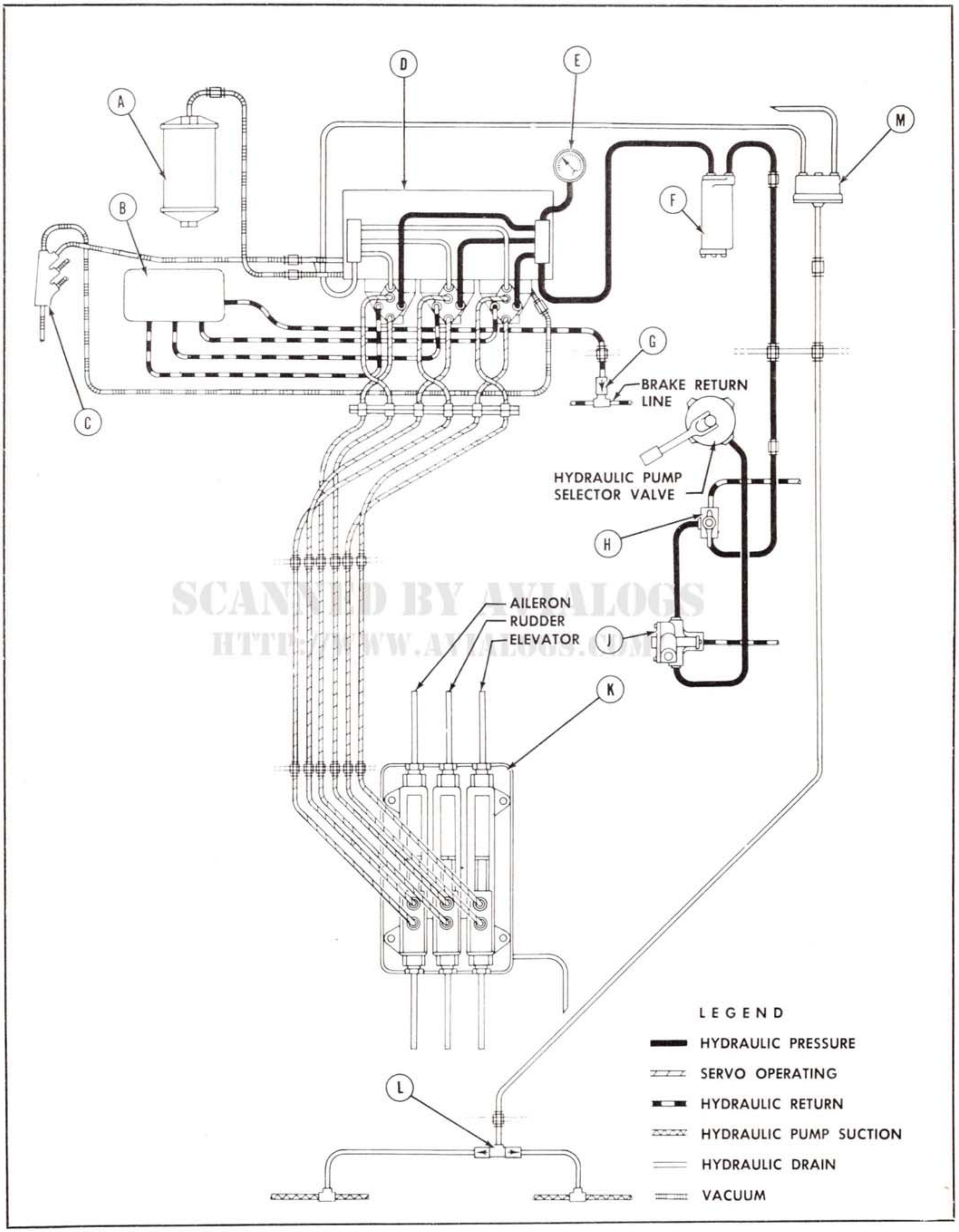

D
E
A
M
B
F
G
BRAKE RETURN LINE
C
HYDRAULIC PUMP SELECTOR VALVE
H
AILERON
RUDDER
ELEVATOR
J
K
L
LEGEND
HYDRAULIC PRESSURE
SERVO OPERATING
HYDRAULIC RETURN
HYDRAULIC PUMP SUCTION
HYDRAULIC DRAIN
VACUUM

Figure 319—Automatic Pilot System

KEY TO FIGURE 319

(Douglas Dwgs. 5110549, 5141841. 5202419)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
A	76516	Sperry Air Filter	1
	AN520-10-10	Screw	4
	AF365-1032	Nut	4
	or		
	AF5822-1	Air Filter	*(See figure 313)*
B	644255	Speed Valve (When Sperry Automatic Pilot is Installed)	1
	AF895-B101	Plug	1
	AF811-CT8D	Elbow	1
	AF811-CT45-4D	Elbow	3
	AF895-B102	Plug	2
	or		
	JH3139	Manifold (When Jack & Heintz Automatic Pilot is Installed)	1
C	2118573	Vacuum Manifold	Ref
D	643917	Sperry Mounting Unit	1
	643916	Bank and Climb Control Unit	1
	643915	Directional Control Unit	1
	8-4FT-D	Parker Nipple (for Vacuum Connection)	2
	12-8FT-D	Parker Nipple (for Air Filter Connection)	1
	AF811-CT6D	Elbow (for Drain Line)	1
	8-4-3PTD	Parker Tee (for Pressure Manifold)	1
	AF811-FT4D	Nipple (for Balanced Oil Valves)	9
	117425-4D-009	Spacer	2
	141831-4-14B	Bolt	2
	141831-4-12B	Bolt	2
	141203	Mounting Nut Plate	8
	or		
	JH4000-1	Jack & Heintz Mounting Unit	1
	J-6000	Jack & Heintz Bank and Climb Control Unit	1
	J-5000	Jack & Heintz Directional Control Unit	1
	SK1624-4	Lord Shock Mount (Upper)	2
	SK1624-6	Lord Shock Mount (Lower)	2
	B-20-8	Aileron Follow-up Pulley	1
	B-20-7	Elevator Follow-up Pulley	1
	B-20-5	Rudder Follow-up Pulley	1
	8-4FTD	Nipple (for Vacuum Connection)	1
	12-8FTD	Parker Nipple (for Air Filter Connection)	1
	AF811-CT6D	Elbow (for Drain Line)	1
	8-4-3RTD	Parker Tee (for Pressure Manifold)	1
	AF811-FT4D	Nipple (for Balanced Oil Valves)	1
	112425-4D-009	Spacer	2
	141831-4-14B	Bolt	2
	141831-4-12B	Bolt	2
	141203	Mounting Nut Plate	8
	AF811-FT-8D	Nipple (for Vacuum Connection)	1
	AF895-B100	Fitting	1
E	(See Instrument Chart, section IV, paragraph 11.*h*.)	Automatic Pilot Oil-Pressure Gage	1
F	644100	Hydraulic Oil Filter	1
	or		
	D-3126	Hydraulic Oil Filter	1
	AN520-10-12	Screw	2
	AF365-1032	Nut	2
	8CCCT-D	Parker Elbow	1
	AF811-CT-8D	Elbow	1

KEY TO FIGURE 319—Continued

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
G	1135812	Exhaust Check Valve	1
H	4118981	Automatic Pilot Emergency Shutoff Valve	1
	AF501-A10-7	Screw	4
	AF995-41-8	Lock Wire	1
	2118974	Stop and Name Plate	1
J	644256	Sperry Oil-Pressure Regulator	1
	AF811-CT-8D	Elbow	2
	AN4-6A	Bolt	2
	AF365-428	Nut	2
	or		
	B-3120	Jack & Heintz Oil-Pressure Regulator	1
K	G-3110	Jack & Heintz Servo Unit	1
	4176982	Servo Unit Drip Pan	1
	2117832	Bell Crank	1
	4202911	Cover (Forward)	1
	4202910	Cover (Aft)	1
	1202715	Splice	1
	4116899	Guide Plate	1
	1117831	Shear Link (On some Airplanes)	1
	AN316-6R	Nut (on Some Airplanes)	6
	139187	Clevis	6
	AF811-CT-6D	Elbow	4
	AF811-CT45-6D	Elbow	2
	AN5-10A	Servo Unit Mounting Bolt	4
	AN960-516	Washer	4
	AN365-524	Nut	4
	or		
	644191	Sperry Servo Unit (With Six 172929 Sperry Adapters)	1
	75668	Sperry Drip Pan	1
	2117832	Bell Crank	1
	4202704	Cover (Forward)	1
	4202713	Cover (Aft)	1
	1202715	Splice	1
	4116899	Guide Plate	1
	1117831	Shear Link (On some Airplanes)	1
	AN316-6R	Nut	6
	139187	Clevis	6
	AF811-CT45-6D	Elbow	2
	AN5-10A	Servo Unit Mounting Bolt	4
	AN960-516	Washer	4
	AN365-524	Nut	4
L	525-FT-6D	Parker Drain Check Valve	2
	4-4-6MMT-D	Parker Tee	1
M	641775	Sperry Drain Trap	1
	AN520-416-8	Screw	4
	AF811-CT45-4D	Elbow	1
	AF811-FT-6D	Nipple	1
	AF811-CT45-6D	Elbow	1
	or		
	B-3050	Jack & Heintz Drain Trap	1
	AN520-416-8	Screw	4
	AF811-CT45-4D	Elbow	1
	AF811-FT-6D	Nipple	1

Note

For follow-up cables, see figure 323. For tubing and fittings information refer to figure 633, section VIII.

11. Turn the automatic pilot engaging lever on the pedestal to the "ON" position.

12. Check the automatic pilot for proper operation by turning each trimmer control knob.

13. Check the overpower valves by operating the controls manually against the automatic pilot.

Note

If the controls are moved too far from the automatic control position when overpowering the Jack & Heintz automatic pilot, they will not return automatically when released. Manual movement of the controls back toward the position from which they were overpowered will bring them back within range of automatic control.

14. Disengage the automatic pilot by turning the lever on the pedestal to the "OFF" position.

15. Bleed the air from the automatic pilot system as described following.

WARNING

Preflight bleeding of the air from the automatic pilot system is essential to obtain proper operation of the equipment in flight.

a. Engage the automatic pilot.

b. Rotate all trimmer control knobs clockwise far enough to place the flight controls in their extreme positions. Then continue to rotate the trimmer control knobs until all indices on the gyro control units are offset approximately 10 degrees (½ inch for elevator index). This action holds the balanced oil valves in the open position so that the automatic pilot hydraulic system can be completely flushed.

c. Holding the flight controls manually in their extreme positions, turn the automatic pilot engaging lever to the "OFF" position. Continue to hold the controls in the extreme position for a period of 30 seconds. During this time the flow of hydraulic fluid through the automatic pilot system will automatically force any air in the system back to the hydraulic fluid reservoir.

d. Turn the automatic pilot engaging lever to the "ON" position, rotate the trimmer control knobs counterclockwise, and repeat the bleeding procedure.

Note

Do not confuse the resiliency caused by air in the servo unit with that caused by the natural rebound of stretched cables.

16. Make certain that the automatic pilot can be overpowered manually without applying excessive force on the controls.

17. Disengage the automatic pilot and reset the speed control valves (or sensitivity dials) to the normal operating setting.

18. Check the fluid level in the hydraulic reservoir, replenishing the supply if necessary.

(2) BANK-CLIMB GYRO CONTROL UNIT.

(a) DESCRIPTION. – The bank-climb gyro control unit contains the gyro which supplies the lateral and longitudinal reference for both automatic and manual control of the ailerons and elevators. The caging knob on the unit is provided to lock the gyro gimbals (pivoted rings). The elevator and aileron control knobs on the bank-climb unit may be used to trim the airplane laterally or longitudinally, or to allow the human pilot to control the airplane while the automatic pilot is in operation. The control knobs also may be used to ground-test the operation of the automatic pilot. The alignment and follow-up index markings on the face of the instrument indicate the position of the control surfaces when the automatic pilot is in operation. The alignment and follow-up indices for each control must be matched before the automatic pilot is engaged. A suction gage installed on the bank-climb gyro control unit indicates the vacuum pressure being supplied to the gyros.

(b) REMOVAL.

1. Cage the gyro.

2. Remove the two cap screws from the face of the unit, loosening them equally.

3. Carefully pull the bank-climb control unit out of the mount assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. A bank-climb control unit which is known to be defective shall be replaced. Condition of the unit can be determined without special equipment by substituting a unit which is known to be serviceable. If the substitute unit functions properly in a ground test (paragraph 11.*g.*(1)*(a)*, it may be assumed that the original unit it defective. If the substitute unit also functions improperly, the source of the trouble ordinarily can be traced to a failure in the vacuum supply.

2. Replace worn or defective rubber grommets on the rear connections of the control unit. Apply a thin coating of glycerin or castor oil to the air connection grommets.

3. Replace cracked or broken cover glass.

(d) INSTALLATION.

1. Line up the index markings on the bank-climb gyro control unit by means of the trimmer knobs.

2. With the control surfaces in the "NEUTRAL" position, place the gyro control unit on the slides of the mount assembly and gently push the unit forward into position.

3. Tighten the cap screws in the face of the unit evenly to insure a tight seal and perfect alignment of the air connections.

(3) TURN GYRO CONTROL UNIT.

(a) DESCRIPTION. – The turn gyro control unit provides the directional rudder reference for both

manual and automatic flight control. The caging knob on the unit is installed to lock the gyro gimbals and to establish the desired heading. The turn gyro unit is equipped with two circular cards graduated in 360 degrees of azimuth. The lower, or directional card, may be set to any desired heading by pushing in and turn the caging knob beneath the dial. The upper, or rudder follow-up card, may be set by turning the rudder trimmer knob at the top of the instrument. In flight the rudder trimmer knob is used to trim the airplane manually or alter the course. The rudder trimmer knob also may be used to ground test the operation of the automatic pilot. Readings of the directional and follow-up cards must coincide to obtain automatic control of the airplane to a selected heading. The cards also must be matched before the automatic pilot is engaged.

(b) REMOVAL.

1. Cage the gyro.

2. Remove the two cap screws from the face of the instrument, loosening them equally.

3. Carefully pull the instrument out of the mount assembly. Apply a thin coating of glycerin or castor oil to the air connection grommets.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. The maintenance instructions for the turn gyro control unit are the same as those given for the bank-climb gyro control unit. Refer to paragraph 11.*g.*(2)*(c)*, this section.

(d) INSTALLATION.—Installation is the reverse of the removal procedure.

(4) AUTOMATIC PILOT HYDRAULIC FLUID PRESSURE GAGE. *(See figure 309.)*

(a) DESCRIPTION.—The hydraulic fluid pressure gage is a single, direct reading instrument with a sensitive mechanism consisting of a Bourdon tube. Located on the main instrument panel, the gage indicates the pressure of the hydraulic fluid in the automatic pilot system. Its pressure range is from 0 to 300 psi and the normal operating reading is 120 psi ± 10 psi. Markings are coated with fluorescent material. The gage is connected to the hydraulic fluid pressure manifold with low temperature flexible hose.

(b) REMOVAL.

1. Remove the safety wire and turn the automatic pilot emergency shut-off valve on the hydraulic control panel to the "OFF" position. This isolates hydraulic fluid pressure from the automatic pilot system by diverting the flow from the fluid pressure regulator to the main hydraulic reservoir.

2. Remove the four front mounting screws which attach the gage to the instrument panel.

3. Pull the gage out of the panel far enough to disconnect the flexible hose.

4. Remove the gage and cap the hose and gage openings.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—A defective hydraulic fluid pressure gage shall be replaced by a serviceable instrument.

(d) INSTALLATION. — Reverse the removal procedure. After the automatic pilot emergency shut-off valve has been turned to the "ON" position it will be necessary to bleed the air from the servo unit. Refer to paragraph 11.*g.*(1)*(a)*, this section.

(5) HYDRAULIC FLUID FILTER. *(See figure 320.)*

(a) DESCRIPTION.—Located in the forward, right-hand side of the fuselage nose, the hydraulic fluid filter is installed in the automatic pilot system between the emergency shut-off valve and the oil-pressure manifold. The filter strains all foreign material from the hydraulic fluid prior to its entry into the balanced oil valves and the servo unit. The filter element may be removed for cleaning or replacement without removing the filter case from its bracket or disconnecting the lines. Foreign material which may collect in the filter is one of the most common causes of trouble in the automatic pilot.

(b) REMOVAL. (Not required to clean filter.)

1. Remove the safety wire and turn the automatic pilot emergency shut-off valve to the "OFF" position.

2. Remove the two bolts which attach the filter to the bracket.

3. Disconnect the two lines and remove the filter.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. A defective hydraulic fluid filter shall be replaced.

2. To clean the filter, when the Sperry type is installed, proceed as follows:

a. Cut the safety wire on the six fillister-head screws and remove the screws.

b. Pull the filter assembly and gasket from the filter body.

c. Using a 7/16-inch wrench, remove the nut from the end of the filter element.

d. If the element is covered with a fabric boot, cut the wire which holds the boot in place and remove the boot for cleaning. The boot must be replaced at reassembly so long as it shows a collection of metal chips, filings, or other foreign material.

e. Unscrew the retaining clamp to free the filter elements.

f. Immerse the parts in cleaning solvent and scrub the filter element with a hair bristle brush. Blow on the parts to dry them and inspect for breaks or possible leaks. Install new parts if necessary.

g. Inspect the gasket and replace if it shows signs of breaks or wear.

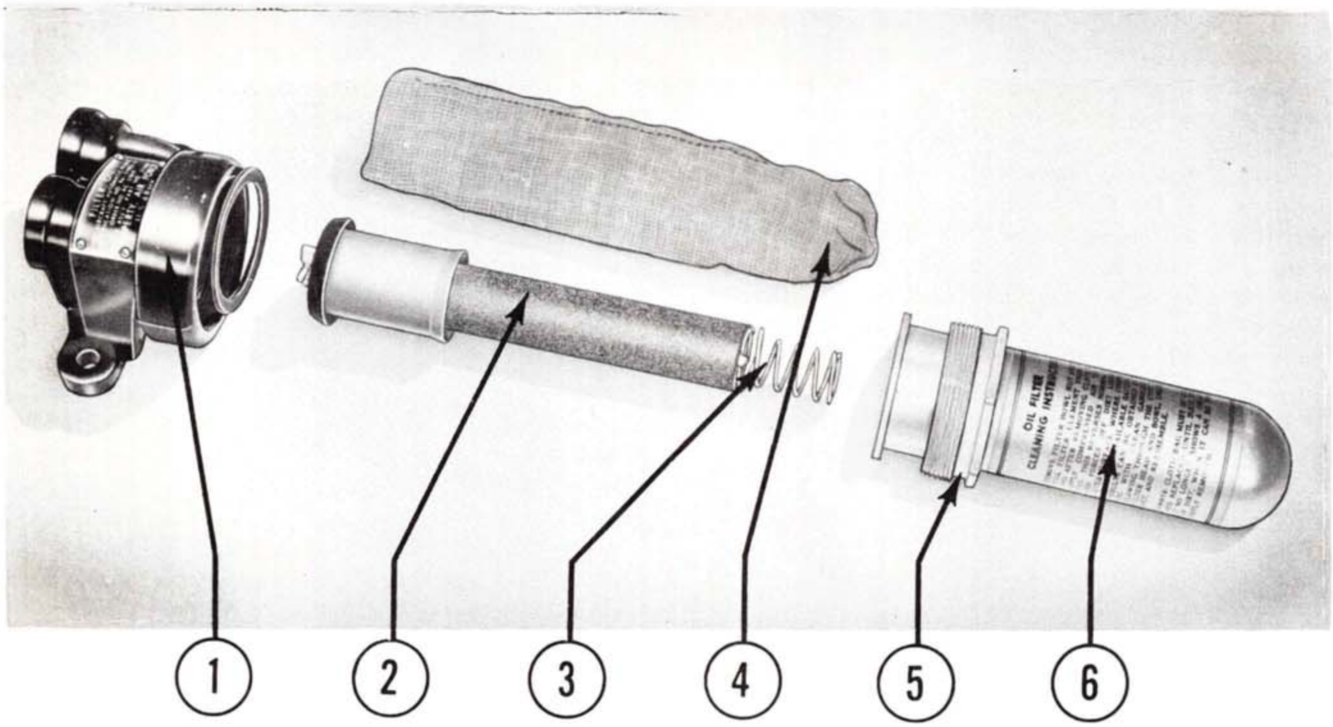


Figure 320—Automatic Pilot Hydraulic Fluid Filter

1. Housing, D-3126 Oil Filter
2. Filter Element
3. Spring
4. Fabric Boot
5. Nut
6. Bowl

h. Replace the filter element assembly with the gasket in place in the body and secure it with the six attaching screws. Secure the screws with safety wire.

3. To clean the oil filter when the Jack & Heintz-Skinner design is used, proceed as follows:

a. Cut the safety wire and remove the large knurled nut and the bowl.

b. Pull out the filter element and remove the fabric boot, if installed.

c. Clean the element with compressed air, applying it at the open end. If air is not available, clean the filter element in clean gasoline and blow through it to dry.

d. Reassemble the filter, making sure that the gaskets are clean and in place. The fabric boot must be cleaned and replaced at each inspection until it no longer shows a collection of foreign material. At that time it may be removed permanently.

(6) HYDRAULIC FLUID PRESSURE REGULATOR.

(a) DESCRIPTION.—The hydraulic fluid pressure regulator reduces the pressure from the hydraulic oil pump to the amount required for the proper operation of the automatic pilot. The regulator returns the fluid to the reservoir whenever the balanced oil valve cuts off circulation to the servos. An adjustment screw covered with an acorn nut is used to adjust the fluid pressure to the amount required at the balanced oil valves. The regulator is located on the aft side of the pilots' compartment bulkhead.

(b) REMOVAL.

1. Bleed the pressure from the main hydraulic system by operating the wing flaps several times.

2. Remove the two bolts which attach the regulator to the bulkhead.

3. Disconnect the three lines and remove the regulator.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. A defective hydraulic fluid pressure regulator shall be replaced.

2. Cleaning ordinarily is the only maintenance required on the regulator. Dirt sometimes causes the adjusting valve in the regulator to become clogged, interfering with the operation of the automatic pilot and causing the indicator on the fluid pressure gage to fluctuate violently. Dirt usually can be dislodged from the adjusting valve without removing the regulator from the bulkhead. Proceed as follows:

a. Turn the adjustment screw out until it is secured by only one or two threads. This will allow fluid to leak out, and a rag should be held around the regulator to soak up the fluid.

b. Instruct an assistant to turn the automatic pilot engaging lever on and off, causing a surge of pressure in the lines. This ordinarily will clear minor obstructions from the valve.

c. Reset the adjustment screw.

(7) HYDRAULIC FLUID DRAIN TRAP.

(a) DESCRIPTION.—A hydraulic fluid drain trap is installed in the automatic pilot system to collect fluid leakage from the balanced oil valves. A float-controlled valve in the trap periodically releases the collected fluid into the hydraulic pump suction line. A vent line which supplies air to the drain trap extends upward in the nose of the airplane to a height above that of the balanced oil valves. There are no provisions for the exterior adjustment of the drain trap.

(b) REMOVAL.

1. Remove the two bolts which attach the filter to the channel.

2. Disconnect the two lines and remove the filter.

3. Cap the lines.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—To clean and service the hydraulic fluid drain trap, proceed as follows:

1. Remove the eight fillister-head machine screws; carefully remove the bottom cover, the float, and the spring.

2. Wash all parts of the drain trap thoroughly in a cleaning solvent; blow, and dry.

3. Examine the float for leaks or damage. The float must be airtight. Check the float valve. Movement of the float must be free and without end play.

4. Check the condition of the gasket. If the gasket is damaged in any way, replace it with a new one.

5. Reassemble the unit, making sure that the spring is in place in the recess in the top of the float and that it enters the recess in the drain trap housing as the bottom cover is replaced.

(8) GYRO CONTROL MOUNT ASSEMBLY.

(a) DESCRIPTION.—The gyro control mount assembly consists of a shock-mounted frame to which air relays, balanced oil valves, and follow-up pulleys are attached. On the Jack & Heintz automatic pilots the air bleed sensitivity controls also are a part of the mount. Installed in the instrument panel, the mount assembly is the support for the bank-climb gyro control unit, and the turn gyro control unit. The gyro units slide into the mount assembly on tracks. All mechanical and air connections on the rear of the gyro control units are made automatically when the control units are bolted into place on the mount assembly. The follow-up pulleys, to which the follow-up cables are attached, are provided with clutch discs which carry their motion to the control unit. Installed in each pulley is a spring which keeps the cable taut during the follow-up action which returns the pick-offs to a "NEUTRAL" position. The air-intake connections for the two gyro instruments are connected to the suction manifold, permitting connections with the air filter which serves all vacuum instruments on the airplane. (On some airplanes a separate air filter has been installed for the automatic pilot.)

(b) REMOVAL.

1. Remove the bank-climb and turn gyro control units.

2. Disconnect the follow-up cables by removing the beads on the ends of the cables from the slots on the follow-up pulleys. Secure the cables to prevent loss of rigging.

3. Remove the long screw from each of the four shock absorber assemblies.

4. Disconnect all the flexible hoses from the mount assembly.

5. Remove the mount assembly.

(c) MAINTENANCE REPAIR.

1. A defective gyro control mount assembly shall be replaced.

2. To determine whether improper operation of the automatic pilot is due to a dirty or sticking air relay-balanced oil valve in the mount assembly, make the following test for freedom of operation and centralization.

a. With the gyro control units removed from the mount assembly and with engines running, turn the automatic pilot "ON." All three controls should remain fixed where they are, as though locked.

b. Connect a rubber tube to one of the nipples of the left-hand air relay (rudder) and blow lightly. This should cause rudder movement as long as the pressure is applied or until the rudder reaches an extreme position. Sucking lightly on the same connection or blowing on the other connection will cause opposite rudder action.

c. As the rudder moves in one direction or the other, the follow-up clutch will be seen to turn one way or the other.

d. If the oil valve is free and properly centralized there should be approximately equal speed of control movement in each direction for the same pressure applied to the air relay, and no creep or movement of the control when there is no suction or pressure applied.

e. The same procedure should be followed for the center air relay (aileron) and for the one on the right (elevator). Up elevator movement will be slower than down elevator due to the weight of the control surface. Manual pressure may be applied to the elevator control column to balance the weight of the control surface.

f. Should the control surface move in one direction when there is no suction or pressure on the air relay, it is an indication of an off-center or sticking condition of the air relay or oil valve.

3. If a balanced oil valve is sticking, the condition may be overcome by removing the rear cap on the valve and then working it back and forth and turning it until it is free. This should be done with oil pressure "ON" and the engaging lever on the control pedestal in the "OFF" position.

4. Worn or defective follow-up pulleys shall be replaced. Lubricate pulley bearings.

(d) INSTALLATION.—Reverse the removal procedure, rigging the follow-up cables on the follow-up pulleys as follows:

1. ELEVATOR FOLLOW-UP CABLE.

a. Place the elevators in the "DOWN" position.

b. Wind the elevator follow-up pulley to the left as far as it will go.

c. Allow the pulley to unwind one-quarter of a turn, rig the cable to the under side of the pulley and insert the cable in the pulley slot.

d. Install the bead on the cable next to the slot and secure it with solder and safety wire.

e. There shall be sufficient tension to hold the cables taut when the elevators are in the extreme "UP" position. Cable pull-off on all pulleys excepting those on the mount assembly shall not exceed 3 degrees.

2. AILERON FOLLOW-UP CABLE.

a. Place the aileron in the "UP" position.

b. Wind the aileron follow-up pulley to the right as far as it will go.

c. Let the pulley unwind one-quarter of a turn, rig the cable over the top of the pulley, and install the bead as described in the case of the elevator follow-up cable.

3. RUDDER FOLLOW-UP CABLE.

a. Turn the rudder to the left.

b. Wind the rudder follow-up pulley to the right as far as it will go.

c. Let the pulley unwind one-quarter of a turn, rig the cable over the top of the pulley and install the bead as described in the case of the elevator follow-up cable.

(9) SPEED CONTROL VALVE ASSEMBLY. *(See figure 308.)*

(a) DESCRIPTION.—A speed control valve assembly is installed on the instrument panel of airplanes equipped with a type A-3 automatic pilot. The assembly is used to regulate the rate of travel of the ailerons, elevators, and rudder when the automatic pilot is in operation. The speed control valve assembly consists of three adjustable valves and the brake return line. A vernier indicating dial is attached to each valve shaft.

(b) REMOVAL.

1. Turn the auto pilot emergency shut-off valve on the hydraulic control panel to the "OFF" position.

2. Remove the four mounting screws from the front of the instrument panel.

3. Disconnect and cap the four flexible lines.

4. Remove the speed control valve assembly from the back of the instrument panel.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. A defective speed control valve assembly shall be replaced.

2. If operation of the speed control valve dials does not obtain the proper response at the flight surfaces the difficulty may be due to clogging. The foreign material may be flushed from the valves as follows:

a. Turn the automatic pilot engaging lever to the "ON" position.

b. Turn the speed control valve dials to the extreme "RIGHT" (open) position.

c. Turn the trimmer knobs to apply a signal at the balanced oil valves.

(10) SERVO UNIT (HYDRAULIC SURFACE CONTROL). *(See figures 321 and 322.)*

(a) DESCRIPTION.—The servo unit (hydraulic surface control) is the mechanism which actuates the flight control cables when the automatic pilot is engaged. The servo unit consists of three cylinders cast together and mounted on the center line of the fuselage beneath the companionway floor. Each cylinder contains a piston with a rod at each end, to which the elevator, aileron, and rudder control cables are attached. Two overpower relief valves are provided on each cylinder so that the human pilot can overcome the automatic pilot if necessary. A bypass valve which diverts the hydraulic fluid from the servo unit when the automatic pilot is disengaged is installed in each cylinder. The bypass valves are controlled by a single shaft which passes through all three cylinders. A bell crank on one end of the shaft is connected by cables to the automatic pilot engaging lever located on the control pedestal. Two ports in each cylinder serve alternately as inlets and outlets for the hydraulic fluid. The ports are connected to the balance oil valves in the mount assembly. On C-47 and early C-47A airplanes only, the servo unit is heated from a duct connected to the pilots' foot warmer.

(b) REMOVAL.

1. Remove the flooring immediately aft of the pilots' compartment bulkhead and beside the forward cargo door.

2. Remove the six screws from the two-piece housing and disconnect the heater duct.

3. Slide the two sections of housing apart and remove them from the servo unit.

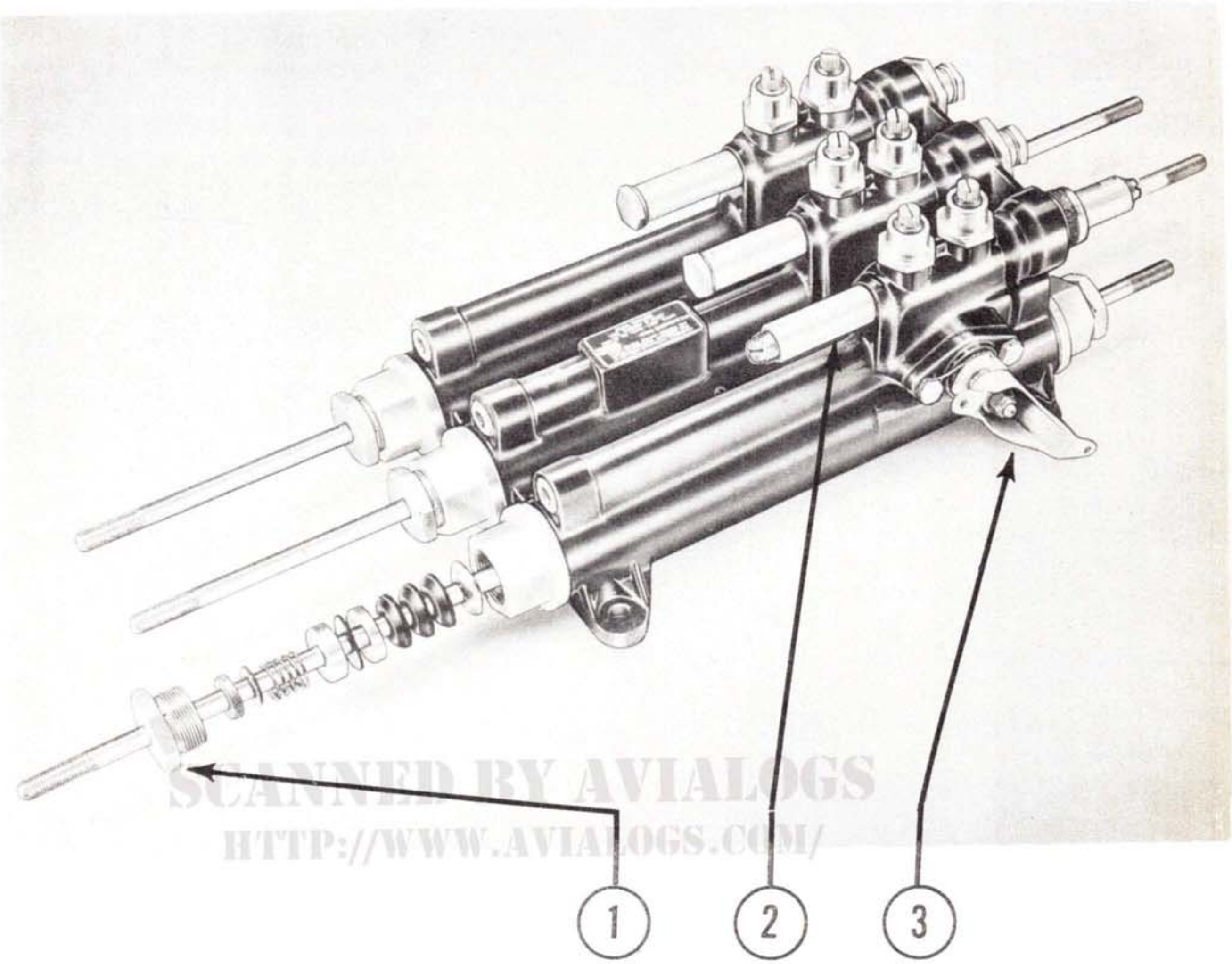


Figure 321—Servo Unit (Jack and Heintz)

1. Servo Piston Rod Gland (Exploded View)
2. Overpower Relief Valve (Adjustment Screw Exposed)
3. Bypass Valve Bell Crank

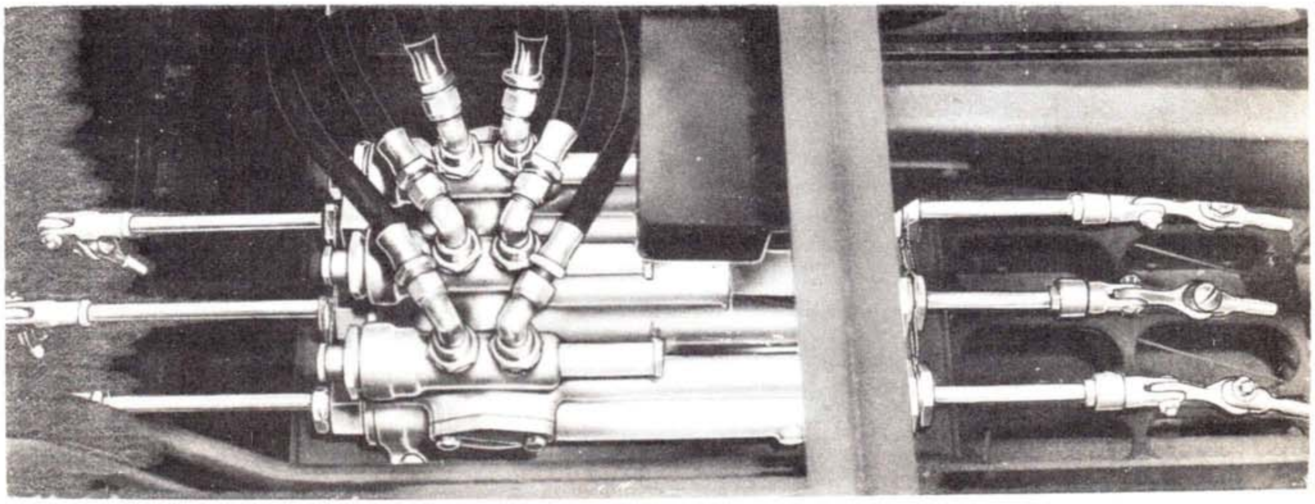


Figure 322—Servo Unit Installed

4. Disconnect the cables from the bypass valve bell crank.

5. Disconnect the flight control cables from each end of the servo unit. Secure the cables to the fuselage structure to prevent loss of rigging.

6. Disconnect the follow-up cables by unscrewing the clevises from the end of the piston rods and sliding off the links to which the cables are attached.

7. Using a 11/16-inch wrench, disconnect the six flexible hoses from the top of the servo unit, leaving them connected to the manifold to their right if desired.

8. Remove the bolt from the forward end of the wobble pump rod, allowing the rod to drop.

9. Remove the four bolts which attach the servo unit to the channels.

10. Work the servo unit to the left and remove it through the opening in the floor beside the forward cargo door.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Tighten the packing nuts on the servo cylinders when leakage of hydraulic fluid exceeds one drop per minute at any one of the six ends. Do not tighten the packing excessively since it may cause a bind on the piston rods.

2. To replace the packing in the servo cylinders without removing the servo unit, proceed as follows:

a. Disconnect the flight control cable from the end of the piston rod, and unscrew the clevis end from the rod.

b. Remove the entire packing gland by unscrewing the larger of the two nuts on the end of the cylinder.

c. Slide the gland assembly off the end of the rod.

d. Disassemble the gland by removing the packing nut.

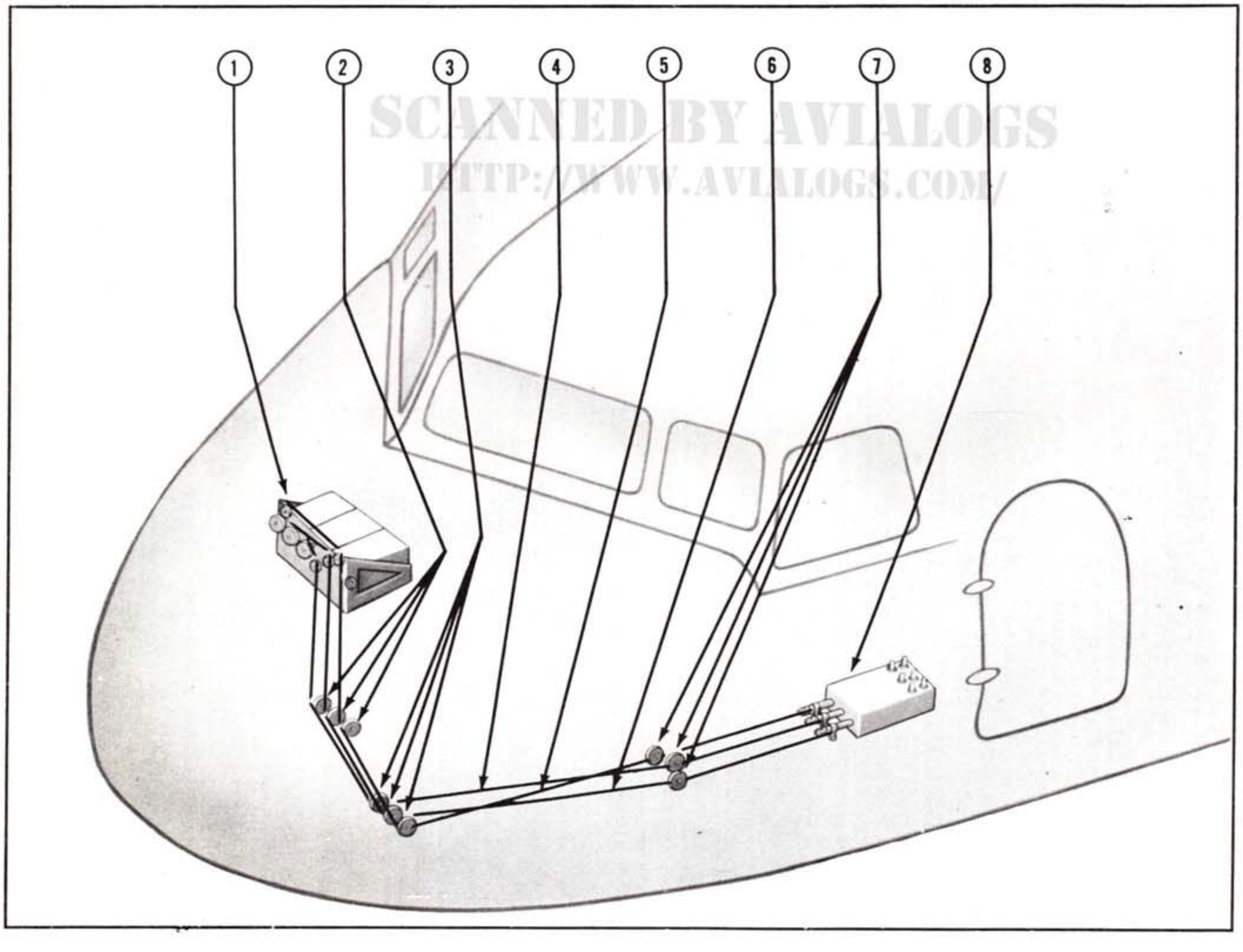


Figure 323—Follow-Up Cable Assembly

e. Remove the packing rings and Chevron packings, carefully noting their positions. Check the metal packing rings for wear and replace them if necessary.

f. Install new Chevron packings and wiper rings.

g. Reassemble the gland but leave the packing nut loose on the threads until the gland has been reassembled on the piston rod.

h. Gently press the gland onto the piston rod, meanwhile turning the gland and its packing nut clockwise so that the Chevron packings in the gland will not be damaged.

i. Screw the gland into the cylinder until fingertight and then give it approximately one fourth of a turn with a wrench. Do not tighten further unless leakage is evident.

3. Replace the shut-off valve bushing if it is worn or broken. Refer to surface controls bushing chart, figure 358.

(d) INSTALLATION.

1. Reverse the removal procedure. The servo unit (figure 322) is mounted with the pipe outlets at the top and the bypass valve bell crank on the left-hand side. The aileron cable attaches to the left piston, the rudder cable to the center piston and the elevator cable to the right piston. The cable from the left arm on the auto pilot engaging lever control shaft in the pedestal connects to the top of the bypass valve bell crank on the servo. The cable from the right arm of the control shaft connects to the bottom of the bell crank. The bell crank turns clockwise to disengage the servo unit and counterclockwise to engage it.

(e) ADJUSTMENT.—The servo overpower relief valves (figure 321) should open readily without excessive manual effort to overpower the automatic pilot. On the other hand the valves should not be set so that they will open during normal flight operation or in rough air.

1. To check the adjustment of the overpower relief valves, proceed as follows:

a. Turn the automatic pilot emergency shutoff valve to the "OFF" position.

b. Turn the automatic pilot engaging lever to the "ON" position.

c. Overpower the flight control and check the hydraulic fluid pressure gage reading. This should be 125 ± 15 psi. The pressure never should exceed 140 psi.

KEY TO FIGURE 323

Item	*Part No.*	*Part Name*	*No. Req per Apl*
1	Sperry 643917 or	Mounting Unit	Ref
	JH 4000-1	Mounting Unit	Ref
2	2130236	Pulley Assembly	1
	Includes		
	AN210-2A	Pulley	3
	AN3-13	Bolt	1
	2130234	Bracket	1
	2130235	Bracket	1
3	2130194	Pulley Assembly	1
	Includes		
	AN210-2A	Pulley	3
	AN3-13	Bolt	1
	2130192	Bracket	1
	2130193	Bracket	1
4	2118819-3	Rudder Follow-up Cable Assembly	1
	2143452-1	Rudder Follow-up Cable Assembly	1
5	2118819-1 or	Elevator Follow-up Cable Assembly	1
	2143452-1	Elevator Follow-up Cable Assembly	1
6	2118819-5	Aileron Follow-up Cable Assembly	1
	2143452-1	Aileron Follow-up Cable Assembly	1
7	2130227	Pulley Assembly	1
	Includes		
	AN210-1A	Pulley	3
	AN3-5	Bolt	2
	AN3-14	Bolt	1
	AN515-8-24	Screw	1
8	644191 or	Sperry Servo Unit (Used on very late C-47B Airplanes only)	Ref
	G-3110 or	J. & H. Servo Unit (Used on very late C-47B Airplanes only)	Ref
	JH3000 or	J. & H. Servo Unit (Used on very late C-47B Airplanes only)	Ref
	JHM-11-D-3A	J. & H. Servo Unit (Used on very late C-47B Airplanes only)	Ref

Note: Refer to section IX for cable manufacturing information.

2. To adjust a servo overpower relief valve when it does not open properly, proceed as follows:

a. Note which way the servo piston has been extended by the flight control.

b. Unscrew the cap from the relief valve retainer tube.

c. Insert a screw driver in the tube.

d. Turn the screw in the tube to the right to increase the pressure required to overpower the valve. Turn the screw to the left to decrease the pressure.

(11) CHECK VALVES. *(See figure 319.)*

(a) DESCRIPTION.—Three check valves are used in the automatic pilot hydraulic system to maintain the flow of fluid in one direction only. The valves are similar in construction, consisting of a housing with inlet and outlet openings, a valve ball or poppet, valve seat, and spring. (Refer to figure 385.) On the Sperry automatic pilot an exhaust check valve is installed at the tee in the line which extends from the speed control valves to the brake return line in the fuselage nose. On the Jack & Heintz automatic pilot, the exhaust check valve is installed at the tee in the line which extends from the automatic pilot manifold to the brake return line. On both types of automatic pilots two drain check valves are installed in the hydraulic fluid drain trap line at the junction with the hydraulic supply line in the center wing.

(b) REMOVAL.

1. DRAIN CHECK VALVES.

a. Turn the automatic pilot emergency shut-off valve to the "OFF" position.

b. Remove the access door (figure 8) located on the under side of the center wing, near the leading edge.

c. Disconnect and cap the lines and remove the drain check valve.

2. EXHAUST CHECK VALVES.

a. Turn the automatic pilot emergency shut-off valve to the "OFF" position.

b. Open the access door in the fuselage nose.

c. Disconnect and cap the lines and remove the exhaust check valve.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—A check valve with worn or defective parts shall be replaced.

(d) TEST BEFORE INSTALLATION.

1. DRAIN CHECK VALVE (1115761).

a. The drain check valve must open at 1½ to 2 psi.

b. Test the body against the ball seat to 10 psi with hydraulic fluid, Specification No. AN-VV-O-366.

c. There shall be no leak at the body but six drops per hour is permissible at the ball seat.

2. EXHAUST CHECK VALVE (1135812).

a. The exhaust check valve must open at 3- to 4-psi hydraulic pressure and must close at static pressure.

b. Test the body against the disk seat to 10 psi with hydraulic fluid, Specification No. AN-VV-O-366.

c. There shall be no leak at the body but six drops per hour are permissible at the disk seat.

(e) INSTALLATION. — Reverse the removal procedure.

(f) MAJOR OVERHAUL.—Refer to paragraph 13.*b.*(12)*(f)*, this section.

(12) AUTOMATIC PILOT ENGAGING LEVER. *(See 29, figure 309.)*

(a) DESCRIPTION.—The automatic pilot engaging lever assembly, located in the control pedestal, consists of a lever, shaft, and bell crank assembly connected by cables to the bypass valve bell crank on the servo unit. When the engaging lever is turned to the "ON" position, the bypass valves are closed, permitting the hydraulic fluid to enter the servo cylinders. When the engaging lever is in the "OFF" position, the bypass valves are open and the hydraulic fluid circulates through the automatic pilot without entering the servo unit.

(b) REMOVAL.

1. Remove the two screws from the face of the automatic pilot engaging lever indicator plate. To hold the nut while removing the right-hand screw, work from the back of the pedestal with an extension ratchet wrench. To hold the nut on the left-hand screw, use a 5/16-inch wrench and work through the small slot on the side of the pedestal.

2. Disconnect the two cables by removing the clevis pins from the bell crank.

3. Remove the bell crank from the shaft by loosening the nut on the taper pin a few turns and then tapping on the nut to loosen the pin.

4. Remove the cotter key from the forward end of the shaft.

5. Pull the engaging lever and shaft assembly out of the pedestal.

(13) AUTOMATIC PILOT EMERGENCY SHUT-OFF VALVE. *(See 5, figure 361.)*

(a) DESCRIPTION.—The automatic pilot emergency shut-off valve is located on the hydraulic control panel. It is installed in the automatic pilot hydraulic fluid pressure line which extends from the hydraulic fluid pressure regulator to the hydraulic fluid filter. The emergency shut-off valve is provided to divert the hydraulic fluid from the automatic pilot system to the hydraulic reservoir. The emergency valve is used only when a leak develops in the automatic pilot hydraulic system, or when it is necessary to remove or service automatic pilot equipment.

WARNING

The automatic pilot emergency shut-off valve should not be confused with the automatic pilot engaging lever, located on the control pedestal. The emergency shut-off valve should be turned to the "OFF" position only when system repair or maintenance is required. The emergency valve is secured in the "ON" position with safety wire.

(14) FOLLOW-UP CABLE ASSEMBLY.
(See figure 323.)

(a) DESCRIPTION.—The three follow-up cables are a part of the automatic pilot mechanism which restores the flight surfaces to their normal attitude after a deviation in course has been corrected. The cables extend from the three follow-up pulleys on the mount assembly to links on the three servo pistons. When a flight cable is actuated the follow-up cable operates the corresponding follow-up pulley on the mount assembly. This pulley in turn operates the follow-up mechanism in the gyro control unit. The cables are attached to the follow-up pulleys by means of beads which fit into slots on the pulleys. On some airplanes the cables are attached to the servo pistons by means of special disconnect links. These links are made up of a plug (part No. 43A12442) and a snap (43A12444) which pull apart under a pressure of 40±5 pounds. The links provide a safety factor if a jammed follow-up cable threatens to foul a flight control cable. On other airplanes the cables are attached to the pistons by means of Dural shear links which break when subjected to a pressure of more than 40 pounds.

(b) REMOVAL.

1. Pull the cable from the slot on the mounting unit pulley and remove the bead, which is both soldered and bolted to the cable.

2. If the plug- and snap-type of shear link is used on the cable at the servo unit, pull the link apart. If a Dural shear link is used, remove the bolt which attaches the cable end to the link on the servo piston.

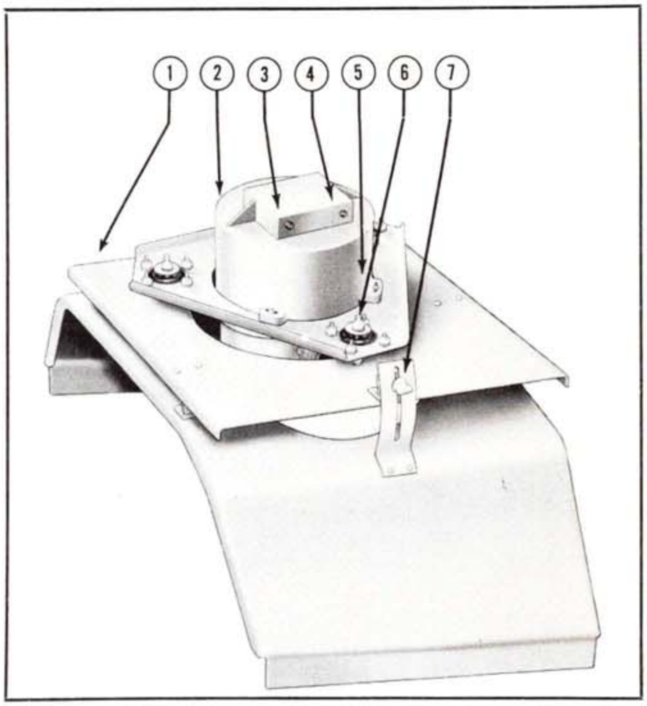


Figure 324—Remote Compass Transmitter on Mounting Table

(Douglas Dwgs. 5205011 and 5203518)

1. Mount Assembly (5205011)
2. Remote Indicating Magnetic Compass Transmitter (AN5730-3)
3. North-South Compass Compensating Screw
4. East-West Compass Compensating Screw
5. Compass Heading Adjustment Lugs
6. Lord Shock Mounts
7. Leveling Adjustment Screw

3. Remove the cable from the airplane.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Follow-up cables which are badly worn or frayed shall be replaced. For cable manufacturing instructions refer to section IX. If a plug- and snap-type of shear link is used on the cable, form a sphere ⅛ inch in diameter on the end of the cable in the snap by winding with three turns of .020-diameter copper wire and soldering.

b. C-47 and C-47A INSTRUMENT CHART.

Part No.	*Part Name*	*No. Req on C-47*	*No. Req on C-47A*	*Reference*	*Spec or Drawing No.*
PITOT-STATIC INSTRUMENTS					
Kollsman 325H-01	Altimeter	2 or		Paragraph 11.*c.*, section IV	
Type C-12 or AN5760-2	Altimeter	2	2	Paragraph 11.*c.*, section IV	94-27957
Pioneer 1423-3G	Air-speed Indicator	2	2 or	Paragraph 11.*c.*, section IV	
Type C-14	Air-speed Indicator		2	Paragraph 11.*c.*, section IV	94-27952
Pioneer 1600-1A or 1M	Rate of Climb Indicator	1		Paragraph 11.*c.*, section IV	
Pioneer 1634-1M	Rate of Climb Indicator		1	Paragraph 11.*c.*, section IV	
Type C-2 or AN5825-1	Rate of Climb Indicator		1	Paragraph 11.*c.*, section IV	94-27967
VACUUM-OPERATED INSTRUMENTS					
Sperry 646040	Gyro Horizon Indicator	1 or		Paragraph 11.*d.*, section IV	
Sperry 643710	Gyro Horizon Indicator	1		Paragraph 11.*d.*, section IV	
AN5736-1	Gyro Horizon Indicator		1	Paragraph 11.*d.*, section IV	AN-GG-I-506
Pioneer 1700-1A	Turn and Bank Indicator	1		Paragraph 11.*d.*, section IV	
Pioneer 1721-2U	Turn and Bank Indicator		1 or	Paragraph 11.*d.*, section IV	
Type A-11 or AN5820-1	Turn and Bank Indicator		1	Paragraph 11.*d.*, section IV	94-27348
AN5735-1	Directional Gyro		1	Paragraph 11.*d.*, section IV	AN-GG-I-496
Sperry 643916	Automatic Pilot Vertical (Turn) Gyro Control	1	1 or	Paragraph 11.*g.*, section IV	
JH-6000	Automatic Pilot Vertical (Turn) Gyro Control		1	Paragraph 11.*g.*, section IV	
Sperry 643915	Automatic Pilot Directional Control Unit	1	1	Paragraph 11.*g.*, section IV	
JH-5000	Automatic Pilot Directional Control Unit		1	Paragraph 11.*g.*, section IV	

Part No.	*Part Name*	*No. Req on C-47*	*No. Req on C-47A*	*Reference*	*Spec or Drawing No.*
ELECTRICALLY-OPERATED INSTRUMENTS					
ID-14/APN-1	Radio Altimeter Indicator		1	Paragraph 15	
AN5730-2	Remote Compass Indicator		2	Paragraph 14.*j.*(9), section IV	AN-GG-C-566
I-65-D	Radio Compass Left-Right Indicator	1 or		Paragraph 15.*d.*, section IV	H38B6029
1-75-A	Radio Compass Bearing Indicator	1		Paragraph 15.*d.*, section IV	H40D3225
I-81-A	Radio Compass Bearing Indicator		1	Paragraph 15.*e.*, section IV	H41D7019
Weston Model 602, Type 58	Free Air Temperature Indicator	1		Paragraph 14.*c.*(4), section IV	
Type C-11	Free Air Temperature Indicator		1 or	Paragraph 14.*j.*(4), section IV	94-27949
AN5790-6	Free Air Temperature Indicator		1	Paragraph 14.*j.*(4), section IV	AN-GG-I-552
Weston Model 606, Type 85	Carburetor Air Temperature Indicator	2		Paragraph 14.*c.*(2), section IV	
AN5795-6	Carburetor Air Temperature Indicator (Dual)		1	Paragraph 14.*j.*(2), section IV	AN-GG-I-552
Weston Model 602, Type 31	Cylinder Head Temperature Indicator	2		Paragraph 14.*c.*(5), section IV	
Type B-11	Cylinder Head Temperature Indicator (Dual)		1	Paragraph 14.*j.*(5), section IV	94-27971
Weston Model 545, Type 54AE	Tachometer	2		Paragraph 14.*c.*(6), section IV	
Type E-9A	Tachometer		2 or	Paragraph 14.*c.*(6), section IV	94-27950A
AN5530-2 or Type E-14	Tachometer (Dual)		1	Paragraph 14.*j.*(6), section IV	AN-I-3 or 94-27355
Weston Model 606, Type 109	Oil Temperature Indicator		2	Paragraph 14.*c.*(3), section IV	

Part No.	Part Name	No. Req on C-47	No. Req on C-47A	Reference	Spec or Drawing No.
ELECTRICALLY-OPERATED INSTRUMENTS—Continued					
Type A-24	Oil Temperature Indicator (Dual)		1 or	Paragraph 14.*j.*(3), section IV	94-27998
AN5795-6	Oil Temperature Indicator (Dual)		1	Paragraph 14.*j.*(3), section IV	AN-GG-I-522
Weston Model 506, Type S-31661	Voltammeter	1 or		Paragraph 14.*b.*(2) (*f*), section IV	
Type F-1	Ammeter	1	1	Paragraph 14.*b.*(2) (*f*), and 14.*i.*(2)(*i*), section IV	94-32284
Liquidometer EA-48-5-12 (V.)	Fuel Quantity Gage	1		Paragraph 14.*c.*(7), section IV	
Liquidometer EA-48-5-24 (V.)	Fuel Quantity Gage		1	Paragraph 14.*c.*(7), section IV	
PRESSURE-TYPE INSTRUMENTS					
Kollsman 298H-01	Manifold Pressure Gage	2	2	Paragraph 6.*c.*(3), section IV	
AN5770-2	Manifold Pressure Gage (Dual)		1	Paragraph 6.*c.*(3), section IV	AN-G-9
U.S. Gage Co. AW-1 7/8-15*	Fuel Pressure Gage	2	2	Paragraph 10.*g.*, section IV	
AN5772-1	Fuel Pressure Gage (Dual)		1	Paragraph 10.*g.*, section IV	AN-G-2
U.S. Gage Co. AW-1 7/8-14CJ	Oil Pressure Gage	2	2	Paragraph 9.*i.*, section IV	
AN5772-2	Oil Pressure Indicator (Dual)		1	Paragraph 11.*e.*, section IV	AN-G-2
Kollsman 225-F-01	De-icer Pressure Gage	1		Paragraph 19., section IV	
AN5771-3	De-icer Pressure Gage		1	Paragraph 19., section IV	AN-G-2

Part No.	*Part Name*	*No. Req on C-47*	*No. Req on C-47A*	*Reference*	*Spec or Drawing No.*
PRESSURE-TYPE INSTRUMENTS—Continued					
U.S. Gage Co. AW-1-7/8 015AV	Oxygen Pressure Gage	1 or		Paragraph 2.*c.*(7) (*a*), section V	
Kidde 23140	Oxygen Pressure Gage	1		Paragraph 2.*c.*(7) (*a*), section V	
Type K-1	Oxygen Pressure Gage		3 or 4	Paragraph 2.*b.*(4), section V	94-27368
1119742	Hydraulic Pressure Gage	2	2	Paragraph 13.*b.*(14), section IV	
Kollsman 131F-04	Automatic Pilot Oil Pressure Gage	1	1	Paragraph 11.*g.*, section IV	94-27920A
H-2 or AN5771-6	Automatic Pilot Oil Pressure Gage		1	Paragraph 11.*g.*, section IV	94-27920A or AN-G-2
MISCELLANEOUS INSTRUMENTS					
Pioneer 1814-1 Type B-77	Magnetic Compass	1		Paragraph 11.*f.*, section IV	
Pioneer 1818-3 Type B-16	Magnetic Compass	1	1	Paragraph 11.*f.*, section IV	94-27807
Pioneer 1818-1A Type B-16	Magnetic Compass		1	Paragraph 11.*f.*, section IV	94-27807
Type D-12	Navigator's Aperiodic Compass	1	1	Paragraph 11.*f.*, section IV	94-27825
Type B-5	Navigator's Drift Meter	1	1	Paragraph 11.*f.*, section IV	94-27402
Pioneer 3310-2	Clock	2			
Type A-11 or AN5743-1	Clock		1		94-27970 or AN-C-99

i. INSTRUMENT TROUBLE SHOOTING.

Trouble	*Probable Cause*	*Remedy*
	AIR-SPEED INDICATORS	
POINTER FAILS TO RESPOND.	Pitot pressure lines not properly coupled to instruments.	Check line connections from air-speed indicator for incorrect assembly.
	Pitot or static lines clogged.	Disconnect pitot and static lines from instruments and clean lines with air pressure. (Refer to paragraph 11.*c.*(3), this section.)
INCORRECT INDICATION.	Leak in pitot-static lines or connections.	Locate leak and repair line.
	Pitot-static tube clogged with foreign material.	Clean pitot-static tube. (See paragraph 11.*c.*(3), this section.)
	Pitot-static tube out of alignment.	Correct position of tube, replacing it if damaged.
	Ice in pitot-static tubes.	Use tube heater. Replace tube if heating element is burned out.
	Leak in indicator case.	Replace instrument.
POINTER VIBRATES.	Excessive vibration in instrument panel.	Replace worn or defective shock mounts. (See paragraph 11.*b.*(2), this section.)
	Indicator not mounted securely.	Tighten attaching bolts.
POINTER OSCILLATES.	Leak in lines or connections.	Locate leak and repair line.
	Case leak in air-speed indicator, rate of climb indicator or altimeter.	Check lines for leak. If an instrument is believed to be at fault, replace it.
POINTER DOESN'T REST AT "ZERO."	Defective mechanism.	Replace indicator.
	ALTIMETERS	
INSTRUMENT INACCURATE.	Foreign material in static pressure openings of tube or in lines.	Disconnect all instruments from static pressure lines and clean tubing with air pressure.
	Case leak or defective mechanism.	Replace instrument.
ROUGH OPERATION, EXCESSIVE FRICTION.	Dirty or defective mechanism.	Replace instrument.
READING TOO HIGH.	Leak in static pressure line.	Find and eliminate leak.
	Pitot-static tube out of alignment.	Line up pitot-static tube. Replace it if damaged.
	RATE OF CLIMB INDICATOR	
POINTER OFF "ZERO."	Shift in mechanism.	Reset pointer by means of external adjustment screw, tap indicator rim lightly to eliminate friction.
POINTER CANNOT BE RESET TO "ZERO."	Broken pivot.	Replace instrument.
POINTER FAILS TO RESPOND.	Obstruction in static line.	Disconnect all instruments connected to static lines and blow lines clear.

Trouble	*Probable Cause*	*Remedy*
	RATE OF CLIMB INDICATOR—Continued	
INSTRUMENT INACCURATE.	Case leak.	Replace instrument.
	Friction due to dirty pivots and jewels.	Replace instrument.
	Pitot-static tube out of alignment.	Align tube. Replace it if damaged.
POINTER OSCILLATES.	Air leak in static lines.	Disconnect all pitot-static instruments and test lines with air pressure.
	TURN AND BANK INDICATOR	
POINTER FAILS TO RESPOND.	Vacuum line clogged or leaking.	Clean, repair, or replace line.
	Clogged air filter.	Clean filter. (See paragraph 11.*d.*(3)*(b),* this section.)
	Restriction valve clogged.	Clean valve.
	Gyro oil thickened by cold.	Replace instrument.
	Dirt in gyro mechanism.	Replace instrument.
INACCURATE READING.	Incorrect air pressure.	See remedies preceding. Readjust restriction valve.
POINTER OSCILLATES.	Excessive vibration in instrument panel.	Check panel shock absorbers and replace if necessary.
POINTER DOES NOT SET AT "ZERO."	Defective instrument.	Replace instrument.
	GYRO HORIZON INDICATOR	
HORIZON BAR FAILS TO RESPOND.	Instrument caged.	Uncage instrument.
	Air filter dirty.	Clean air filter. (See paragraph 11.*d.*(3)*(b),* this section.)
	Vacuum below required 3.75 inches Hg.	Adjust suction relief valve.
	Air leak in vacuum line or connection.	Locate and repair leak.
	Failure of engine-driven vacuum pump.	Replace pump.
HORIZON BAR FAILS TO SETTLE.	Excessive panel vibration.	Check panel shock mounts and replace if worn or defective.
	Insufficient vacuum.	Adjust suction relief valve.
	Defective instrument.	Replace instrument.
HORIZON BAR OSCILLATES.	Gyro not completely uncaged.	Uncage gyro.
	Air filter dirty.	Clean air filter. (See paragraph 11.*d.*(3)*(b),* this section.)
	Excessive vacuum.	Adjust suction relief valve.
	Excessive panel vibration.	Check panel shock mounts and replace if worn or defective.

j. AUTOMATIC PILOT TROUBLE SHOOTING.

Trouble	*Probable Cause*	*Remedy*
INSUFFICIENT VACUUM (less than 3-¾ inches Hg).	Air intake filter clogged.	Clean filter element.
	Suction relief valve not properly adjusted.	Adjust suction relief valve.
	Vacuum pump failure.	Replace vacuum pump.
	Leak in vacuum line.	Locate and repair leak.
	Defective suction gage.	Replace suction gage.
EXCESSIVE VACUUM (over 4-¼ inches Hg).	Suction relief valve not properly adjusted.	Adjust suction relief valve.
	Defective suction relief valve.	Replace suction relief valve.
	Defective suction gage.	Replace suction gage.
INSUFFICIENT HYDRAULIC OIL PRESSURE.	Hydraulic fluid filter clogged.	Clean hydraulic fluid filter.
	Hydraulic fluid supply low.	Replenish hydraulic fluid reservoir. (Refer to instruction plate beside reservoir.)
	Hydraulic fluid pressure regulator not properly adjusted.	On type A-3 automatic pilot, adjust regulator with speed control valve closed.
	Hydraulic fluid pressure regulator dirty.	Clean regulator.
	Hydraulic fluid pump intake line clogged.	Check, clean line.
	Defective hydraulic fluid pump.	Replace pump. (Refer to paragraph 13.*b*.(3)*(b)*, this section.)
	Automatic pilot emergency shut-off valve in "OFF" position.	Turn valve to "ON" position.
	Hydraulic fluid pressure gage defective.	Replace gage.
EXCESSIVE HYDRAULIC OIL PRESSURE.	Hydraulic oil-pressure regulator not properly adjusted.	On type A-3 automatic pilot, adjust regulator with speed valves closed.
NO CONTROL.	Shut off lever on pedestal in "OFF" position.	Turn lever to "ON" position.
	Insufficient vacuum.	Refer to remedy for insufficient vacuum preceding.
	Insufficient hydraulic fluid pressure.	Refer to remedy for insufficient hydraulic oil pressure, preceding.
	Break in connection between automatic pilot shutoff lever and valve at servo unit.	Locate and repair break.
	Speed control valves closed (on type A-3 automatic pilot).	Open speed control valves.

Trouble	*Probable Cause*	*Remedy*
FAILURE OF ONE OF CONTROLS.	Corresponding speed control valve or sensitivity control closed.	Open valve or control.
	Corresponding balanced oil valve stuck.	Loosen valve. (See paragraph 11.*g*.(8) *(c)*, this section.) If valve is defective, replace.
	Mounting unit defective.	Check condition of rubber grommets at rear and replace if necessary. Otherwise, replace mounting unit.
	Air relay stuck.	Clean or replace air relay.
CONTROLS OSCILLATING.	Air in hydraulic fluid system.	Bleed air from servo. (Refer to paragraph 11.*g*.(1)*(a)15*.a., this section.)
	Lag in follow-up.	Check condition of follow-up cables and pulleys.
	Balanced oil valve sticking.	Loosen valve. (See paragraph 11.*g*.(8) *(c)*, this section.) If valve is defective, replace.
	End play in balanced oil valve.	Adjust valve.
	Caged gyros.	Uncage gyros.
CONTROL JERKY.	Follow-up pulleys sticking.	Remove gyro units and lubricate pulleys and bearings on mounting unit.
	Friction in follow-up hook-up.	Check condition of follow-up pulleys, cables and springs.
	Balanced oil valves sticking.	Loosen valve. (See paragraph 11.*g*.(8) *(c)*, this section.) Replace valve if defective.
	Control unit air signal unbalanced.	Check with control unit known to be in good condition. If defective, replace.
CONTROL LAGGING (ONE DIRECTION ONLY).	Corresponding follow-up pulley spring not wound sufficiently.	Rewind spring, or replace.
	Corresponding balanced oil valve sticking.	Loosen valve. (See paragraph 11.*g*.(8) *(c)*, this section. Replace valve, if defective.
	Corresponding oil valves not centralized.	Adjust valves.
	Control unit air signal too low.	Check with control unit known to be good. If defective, replace.
CONTROL LAGGING IN BOTH DIRECTIONS.	Hydraulic fluid filter dirty. Hydraulic fluid pressure falls to low reading each time automatic pilot operates.	Clean filter thoroughly. (See paragraph 11.*g*.(5)*(c)*, this section.)
	Speed control valve setting too low on type A-3 auto pilot. Sensitivity control setting too low on type A-3A-1 auto pilot.	Increase valve or sensitivity control setting.

Trouble	*Probable Cause*	*Remedy*
CONTROL LAGGING IN BOTH DIRECTIONS—Cont'd	Hydraulic fluid pressure too low.	Adjust fluid pressure regulator.
	Hydraulic fluid supply choked.	Check interior of flexible hose, especially suction line to pump. Check oil supply line and clean if necessary.
	Vacuum pressure low.	Refer to remedies for insufficient vacuum.
CONTROL IN ONE DIRECTION ONLY.	Balanced oil valve restricted by dirt.	Clean valve. (See paragraph 11.*g*.(8)(*c*), this section.)
	Air leak at air pick-off grommet between control unit and mounting unit.	Replace grommet.
EXCESSIVE DRIFT.	Turn gyro affected by vibration in mounting unit.	Check condition of mounting unit shock absorbers. Note if any connections are pulling.

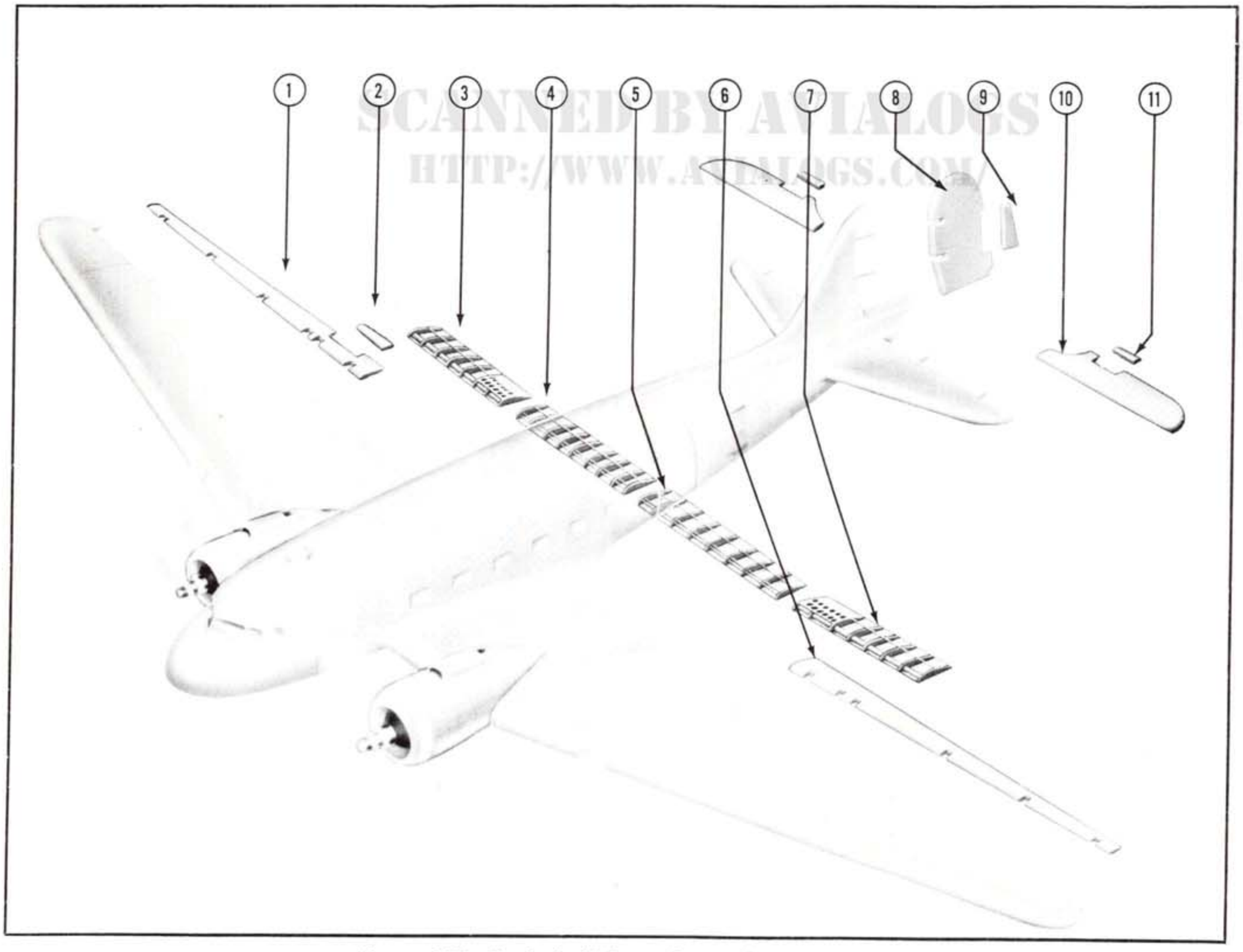


Figure 325—Exploded View of Movable Surfaces

12. SURFACE CONTROLS.

a. GENERAL.—The movable surfaces on the airplane consist of two ailerons, the right aileron trim tab, two elevators, two elevator trim tabs, the rudder, the rudder trim tab, and the wing flaps. All of these surfaces excepting the wing flaps are operated manually from the pilots' compartment by means of conventional controls and cable systems. The wing flaps are hydraulically operated. An automatic pilot provides automatic control of the airplane when this is desired.

b. MOVABLE SURFACES.

(1) AILERONS. *(See figure 325.)*

(a) DESCRIPTION.—The two ailerons consist of aluminum-alloy frames covered with treated fabric. Each aileron is hinged to the wing at six points and is counterbalanced by weights built into the aileron structure. An adjustable metal trim tab is installed on the right-hand aileron. A fixed trim tab, consisting of a metal strip, projects from the trailing edge of the left-hand aileron. Bending of this tab up or down provides an adjustment of approximately 3 degrees in the airplane's lateral attitude. Adjustment of this tab is necessary only when the required setting of the movable trim tab exceeds 2 degrees when the airplane is properly loaded and fueled. Up motion of the aileron is 27 degrees ± ½ degree, or 13 inches ± ⅛ inch, measured at the root. Down motion is 18 degrees ± 2 degrees, or 8 inches ± ½ inch, measured at the root. Aileron droop when the airplane is on the ground is 1½ degrees ± ½ degree, or ⅞ inch ± ⅛ inch. Up motion of the aileron tab is 12-½ degrees ± ½ degree, or 2 inches ± ⅛ inch. Down motion of the aileron tab is 12-½ degrees ± ½ degree, or 2 inches ± ⅛ inch. Methods of adjusting aileron and aileron tab motion are described in paragraph 12.*c.*(1)*(b)*, and paragraph 12.*c.*(2)*(b)*.

(b) REMOVAL.

1. AILERONS.

a. Remove the screws from the hinged aileron gap covers.

b. If the right aileron is being removed, disconnect the aileron trim tab operating arm, working through the access door (figure 9) in the wing.

c. Detach the two aileron control rods by removing the bolts from each control rod clevis.

d. Detach the bonding strips on the inboard and outboard hinges.

e. Remove the cotter pins and nuts from the eyebolts at the six aileron hinge points. Start at the center of the aileron and work to the ends. (Two men are required.)

f. Remove the aileron by pulling it aft.

2. AILERON TRIM TAB.

a. Gain access to the aileron by removing the screws from the lower half of the fairing located on the leading edge of the aileron forward of the tab.

b. Detach the tab actuating rod from the aileron by removing the clevis bolt.

c. Remove the horizontal hinge pin. Because of wear and corrosion, this pin sometimes is difficult to remove. A hammer and punch may be required to start the pin.

d. Remove the tab with the actuating rod attached.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. For information on the repair of the structure or fabric covering of the ailerons, refer to T. O. No. 01-40NC-3.

2. Replace worn or broken bushings. (See figure 358.)

(d) INSTALLATION.—To install an aileron or tab, reverse the removal procedure. If adjustment of the aileron push-pull rod or the control cables is necessary to obtain correct travel of the aileron, refer to paragraph 12.*c.*(1)*(b)*, this section.

(e) ADJUSTMENTS.—For instructions on the adjustment of aileron and aileron tab movement, refer to paragraph 12.*c.*(1)*(b)*, and paragraph 12.*c.*(2)*(b)*, this section.

(f) TEST AFTER INSTALLATION. — Check the aileron and the aileron control wheel for proper movement.

KEY TO FIGURE 325

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	5115202-1	Right Aileron	1
2	5115203	Aileron Trim Tab	1
3	5115204-1	Right Outer Wing Flap	1
4	5115205-1	Right Center Wing Flap	1
5	5115205	Left Center Wing Flap	1
6	5115202	Left Aileron	1
7	5115204	Left Outer Wing Flap	1
8	5115212	Rudder	1
9	5115213	Rudder Trim Tab	1
10	5115210	Elevator	2
11	5115211	Elevator Trim Tab	2

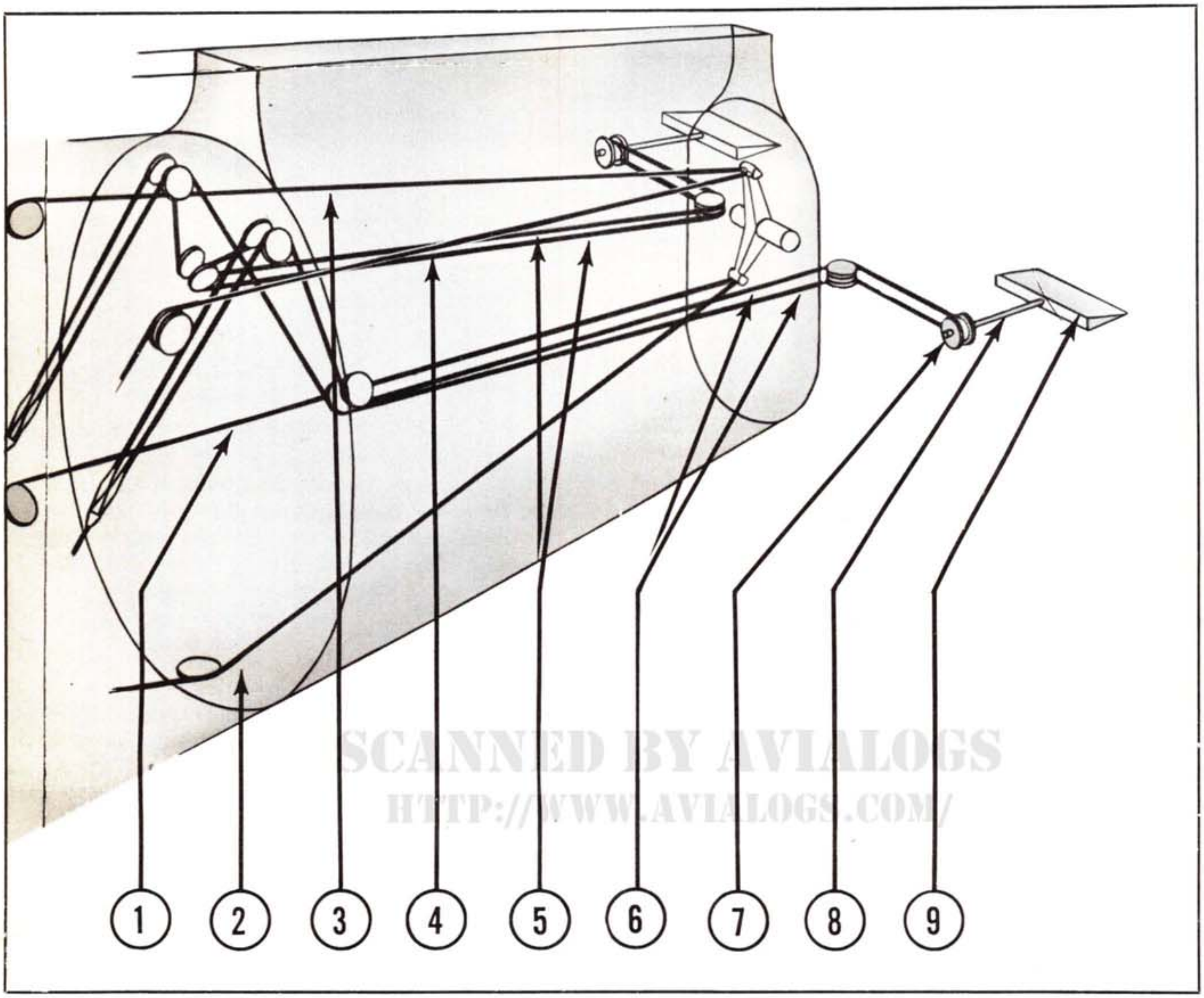


Figure 326—Elevator and Elevator Tab Controls in Aft Section

(For cable manufacturing information refer to section IX. Also see figure 345.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2074410-7-9-12628	Lower RH Elevator Cable	1
2	2074410-7-9-12628	Lower LH Elevator Cable	1
3	2074410-7-9-15516	Upper RH Elevator Cable	1
4	2074410-7-9-15516	Upper LH Elevator Cable	1
5	2074406-4-4-497	RH Elevator Tab Cable	1
6	2074406-4-4-497	LH Elevator Tab Cable	1
7	271044	Elevator Tab Drum	2
8	2116937	Actuating Rod Assembly	2
9	5115211	Elevator Trim Tab	2

(2) ELEVATORS. *(See figure 325.)*

(a) DESCRIPTION.—The two elevators consist of aluminum-alloy frames covered with treated fabric. Each elevator is hinged to the horizontal stabilizer at two points and is counterbalanced by weights built into the elevator structure. An adjustable trim tab of all-metal construction is installed on each elevator. Upward motion of the elevators is 30 degrees ± ½ degree, or 12 inches ± ⅛ inch, measured at the root. Downward motion of the elevators is 20 degrees ± ½ degree, or 8 inches ± ⅛ inch, measured at the root. Up and down motion of the tab is the same: 12 degrees ± ½ degree, or 1-⅝ inches ± ⅛ inch. Methods of

adjusting elevator motion are described in paragraph 12.*c.*(3)*(b)*, this section.

(b) REMOVAL.

1. ELEVATORS.

a. At the turnbuckles in the fuselage aft section (figure 326), disconnect the tab control cables which extend to the elevator being removed. (There are four cables at this point, two to each elevator tab.)

CAUTION

> Tape the tab drum (figure 327) in the affected elevator and fasten the cable ends to the elevator structure to prevent the cables from unwinding. If one elevator is being removed, it will not be necessary to tie the cables forward of the disconnect point. Tension will be maintained by the cables from the drum in the other elevator. However, if both elevators are being removed, it will be necessary to tie the cables forward of the links (three-way connecting plates) and tape the drum in the control pedestal.

b. If the right elevator is being removed, detach the two elevator pulleys located in the fuselage on the right, forward end of the horizontal stabilizer; also, detach the right pulley from each of the two sets attached to the top of the fuselage at the same location. If the left elevator is being removed, detach the left pulleys.

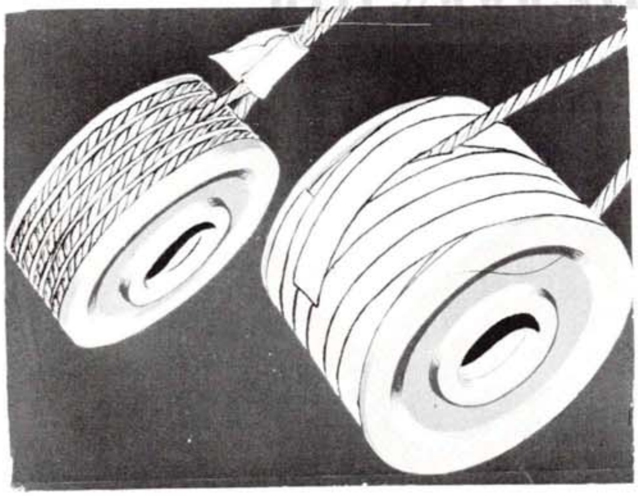


Figure 327—Trim Tab Drum Taping Procedure

c. Remove the guard pins from the two tab pulleys attached to a bracket on the aft edge of the horizontal stabilizer.

d. Remove the bolts which connect the elevator to the elevator torque tube. (See figure 328.)

e. Detach the bonding strips at the elevator hinge points.

f. Remove the cotter pins and nuts from the eyebolts at the hinge points. (Two men are required.)

g. Remove the left elevator by pulling it

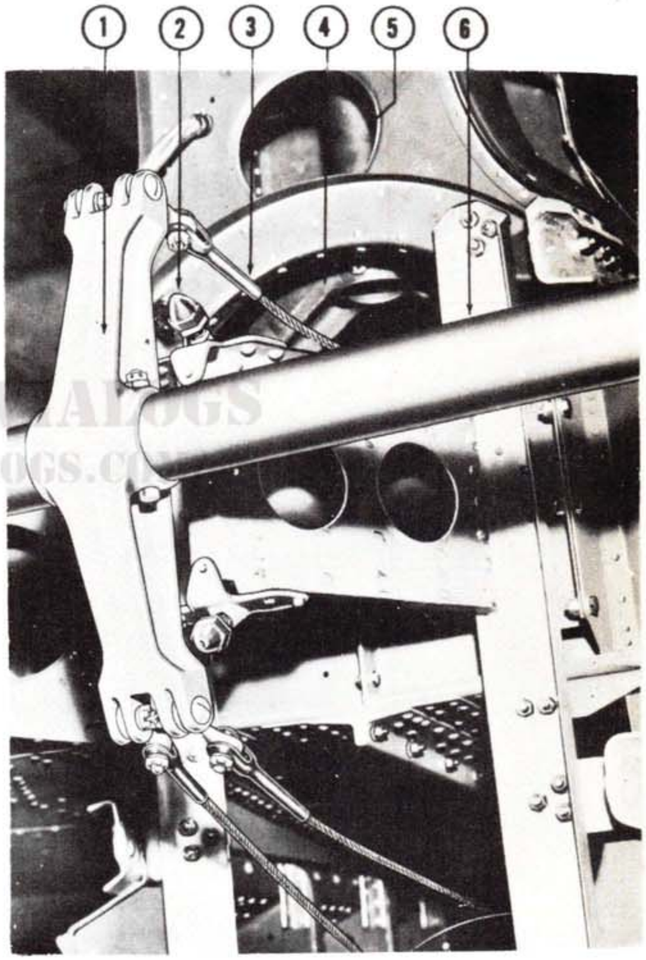


Figure 328—Elevator Horn and Stop Assembly

KEY TO FIGURE 328

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	5115163	Elevator Stock Horn	1
2	1115152	Bumper Stud Assembly	2
3	2074410-7-9-15516	Elevator Cable Assembly	1
4	5118056 or 5204092	Rudder Horn	1
5	5118595-2	Rudder Torque Tube	1
6	5115162-1	Elevator Torque Tube	1

down, and then aft. Remove the right elevator by lifting it up, and then aft.

2. ELEVATOR TAB.

a. Disconnect the tab actuating tube from the elevator by removing the bolt.

b. Remove the bolt from the tab center hinge.

c. Peel off the patches which cover the small, angular access openings (figure 329) located in the elevator fabric beside the inner and outer hinge points.

d. Remove the bolts from the two end hinges.

e. Remove the elevator tab.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. For information on the repair of the structure or fabric covering of the elevators, refer to T. O. No. 01-40NC-3.

2. Replace worn or broken bushings. (See bushing chart, figure 358.)

(d) INSTALLATION.—To install the elevators or tabs, reverse the removal procedure.

(e) ADJUSTMENTS. – For instruction on the adjustment of elevator and elevator tab movement, refer to paragraphs 12.*c*.(3)*(b)* and 12.*c*.(4)*(b)*, this section.

(f) TEST AFTER INSTALLATION. – Check the elevators, the elevator tabs, the control column, and the trim tab control for proper movement.

(3) RUDDER. *(See figure 325.)*

(a) DESCRIPTION.—The rudder consists of an aluminum-alloy framework covered with treated fabric. The rudder is hinged to the vertical stabilizer at two points and is balanced by means of counterweights built into the structure. An adjustable, metal trim tab is installed on the trailing edge. Rudder motion, left or right, is 29½ degrees, ± 1 degree, or 26½ inches ± ¼ inch. Rudder tab movement, left or right, is 12 degrees ± ½ degree, or 2¾ inches ± ⅛ inch. Methods of adjusting the rudder or rudder tab motion are described in paragraphs 12.*c*(5)*(b)* and 12.*c*(6)*(b)*, this section. The rudder hinge bracket support is attached to the rudder by bolts, washers, and nuts.

(b) REMOVAL.

1. RUDDER.

a. Tape the tab drums in both the control pedestal and the rudder to prevent the cables from unwinding. (See figure 327.) Tie the cables forward of

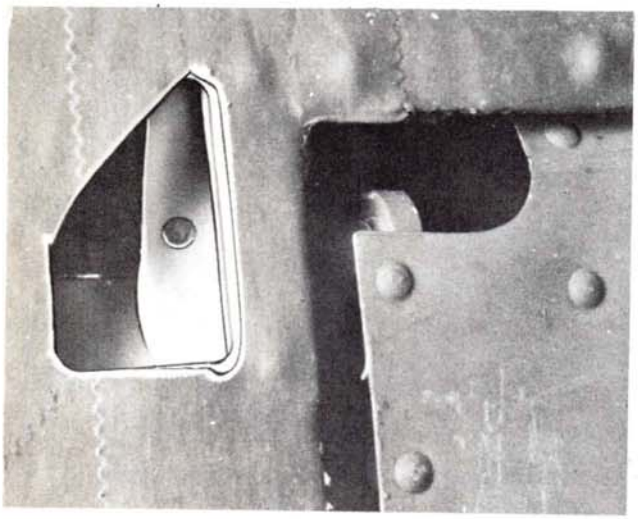


Figure 329—Elevator Tab Hinge Bolt Access Door

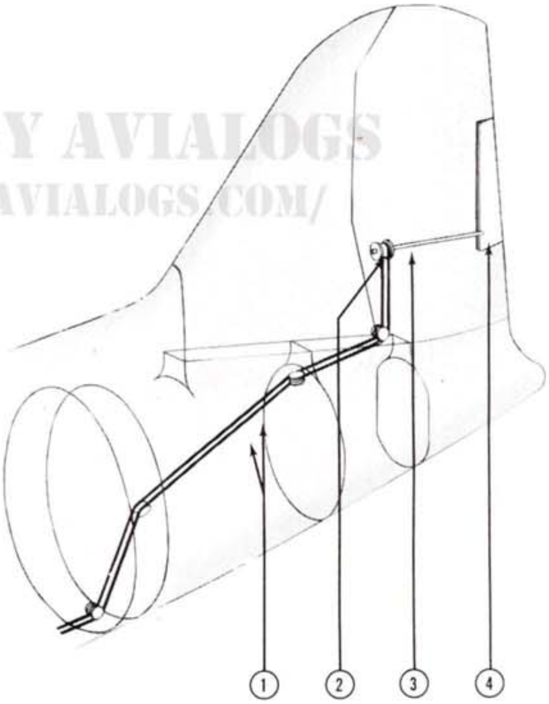


Figure 330—Rudder Tab Controls in Aft Section

KEY TO FIGURE 330

(For cable manufacturing information refer to section IX. Also see figure 353.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2074406-4-4-34616	Rudder Tab Cable	1
2	271044	Rudder Tab Drum	1
3	2116938	Tab Actuating Rod	1
4	5115213	Rudder Tab Assembly	1

the disconnect point to the fuselage structure and those aft to the rudder.

b. Disconnect the rudder tab cables at the turnbuckles (figure 330) located on the left-hand side of the fuselage above the tail wheel.

c. Remove the guard pin from the pulley attached to the fuselage structure above and at about the center of the horizontal stabilizer.

d. Remove the bolts which attach the rudder to the rudder torque tube.

e. Remove the bonding strips from the rudder.

f. Remove the cotter pins and nuts from the eye bolts at the hinge points.

g. Remove the rudder by tipping it at the top to clear the horn, and then lowering it. (Three men are required.)

2. RUDDER TAB.

a. Disconnect the actuating tube from the tab by removing the clevis bolt.

b. Remove the center hinge bolt.

c. Peel off the patches which cover the small, angular access openings located in the rudder fabric beside the upper and lower hinge points.

d. Remove the bolts from the two end hinges.

e. Remove the tab.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. For information on the repair of the structure or fabric covering of the rudder, refer to T. O. No. 01-40NC-3.

2. Replace worn or broken bushings.

(d) INSTALLATION.—To install the rudder, reverse the removal procedure.

(e) ADJUSTMENTS.—For instructions on the adjustment of the movement of the rudder or rudder trim tab, refer to paragraphs 12.*c.*(5)*(b)* and 12.*c.*(6)*(b)*, this section.

(f) TEST AFTER INSTALLATION. – Check the rudder and the rudder pedals for proper movement.

(4) WING FLAPS. *(See figures 325 and 331.)*

(a) DESCRIPTION.—Four metal wing flaps of the split-trailing-edge-type are provided. The flaps extend between the inboard ends of the ailerons and function as a single unit. They are hinged to the under side of the airplane and are hydraulically operated. The down movement of the flaps is 45 degrees ± 2 degrees. A wing flap rigging procedure will be found in paragraph 12.*c.*(7)*(b)*, this section.

(b) REMOVAL.

1. With the flaps lowered, disconnect the turnbuckles which connect the flaps to the operating tubes.

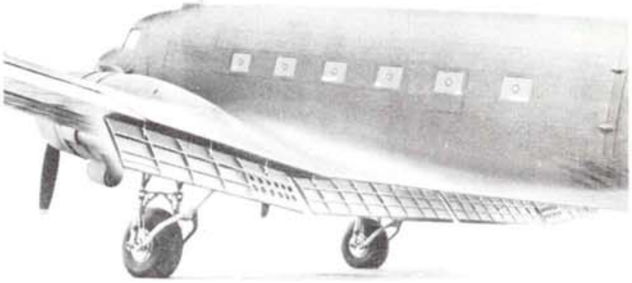


Figure 331—Wing Flaps Extended

2. Pull the pins out of the wing flap hinges. (Two men are required.)

3. Remove the wing flaps by pulling them downward.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. For information on the repair of the structure of the wing flaps, refer to T. O. 01-40NC-3.

2. Replace worn or broken bushings. (See bushing chart, figure 358.)

(d) ADJUSTMENTS.—For instructions on the rigging of the wing flaps, refer to paragraph 12.*c.*(7)*(b)*, this section.

(e) INSTALLATION.—To install the wing flaps, reverse the removal procedure.

(f) TEST AFTER INSTALLATION. – Check the wing flaps for proper movement.

c. SURFACE CONTROLS.

(1) AILERON CONTROLS. *(See figure 332.)*

(a) DESCRIPTION.—Aileron movement is controlled by means of dual-control wheels mounted on the dual-control column. (See figure 333.) Wheel motion is transmitted to the aileron cables by means of a sprocket and chain (figure 334) attached to the shaft of each wheel. The aileron cables are attached to the chains in the upper elbows of the column. From this point the cables are guided on pulleys to the base of the column and aft through the fuselage to the center wing. The cables from each wheel are joined by means of links in the center wing and directed to the aileron master differential horn. From the horn the cables extend outboard through each wing and connect to the aileron actuating cranks. The cranks are linked to the ailerons by means of push-pull tube assemblies. Movement of the control wheels and the ailerons is limited by stops (figure 334) provided on the chains in the control column elbows. One of the aileron control cables is linked with the automatic pilot hydraulic servo unit (figure 335), located beneath the companionway floor. For information concerning the automatic pilot, refer to paragraph 11.

(b) ADJUSTMENTS.

1. Following is a procedure for the rigging,

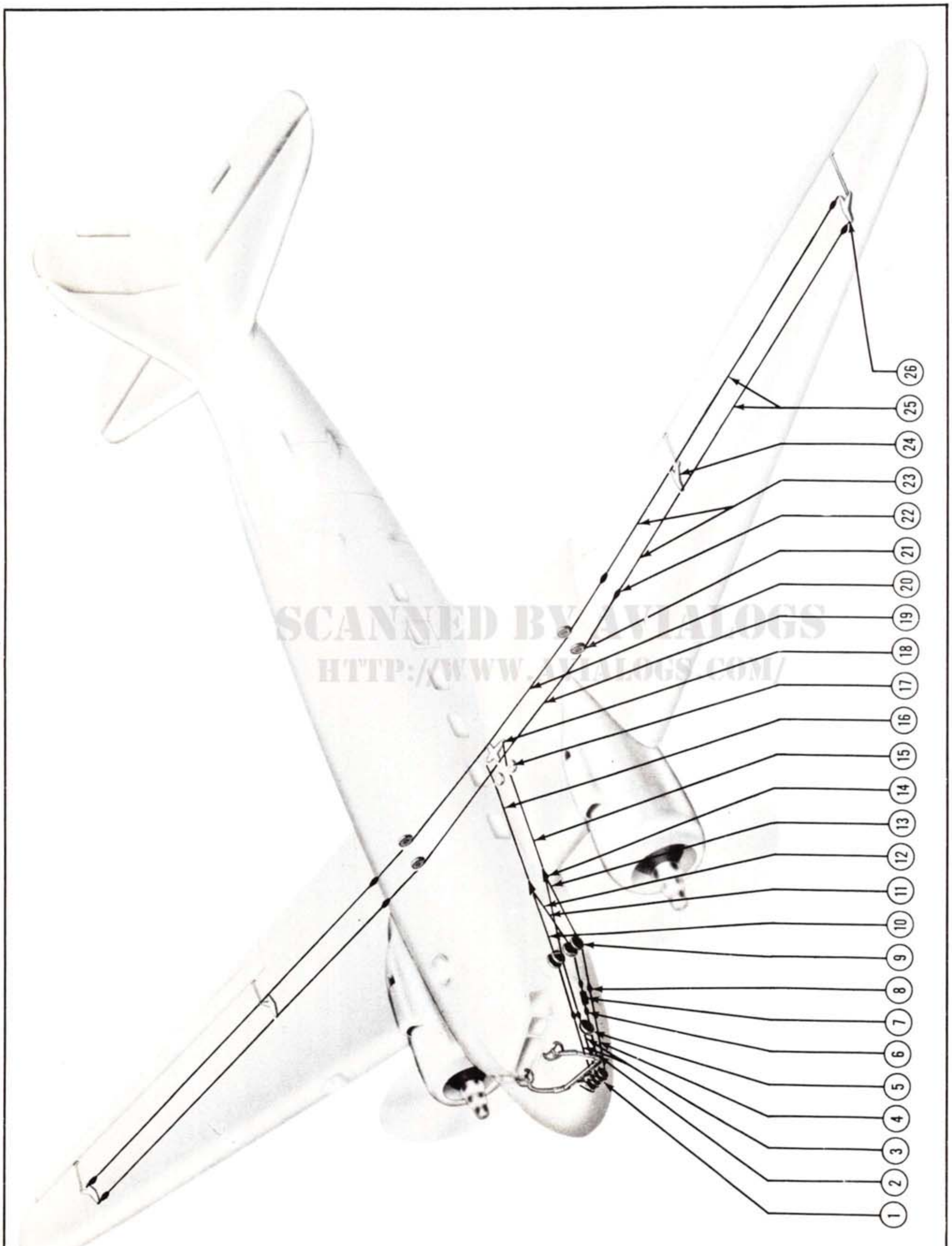

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

Figure 332—Aileron Controls

KEY TO FIGURE 332

(For cable manufacturing information refer to section IX.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	AN210-4A	Pulley	8
2	2074410-4-0-9212	Cable—Servo to Column	1
3	2074410-7-0-9428	Cable—Turnbuckle to Column	2
4	2074410-7-0-12228	Cable—Turnbuckle to Column	1
5	AN210-3A	Pulley	1
6	AN155-46S	Turnbuckle Barrel	2
7	See figure 335	Servo Unit	Ref
8	AN155-46L	Turnbuckle Barrel	3
9	AN210-3A	Pulley	4
10	2074410-6-8-11224	Cable—Link to Turnbuckle	1
11	2074410-4-8-8916	Cable—Link to Servo Unit	1
12	2074410-6-8-8720	Cable—Link to Turnbuckle	1
13	2074410-6-8-11704	Cable—Link to Turnbuckle	1
14	1118566	Link	2
	AN5-7	Bolt	6
	AN310-5	Nut	6
15	2074410-8-8-8606	Cable—Horn to Link	1
16	2074410-8-8-8606	Cable—Horn to Link	1
17	AN210-3A	Pulley	2
18	4117386	Aileron Horn	1
	AN6-45	Bolt	1
	AN310-6	Nut	1
19	2074410-7-9-16720	Cable—Turnbuckle to Link	2
20	2074410-7-9-16620	Cable—Turnbuckle to Link	2
21	AN210-3A	Pulley	4
22	AN155-46L	Turnbuckle Barrel	8
23	2074410-6-8-8920	Cable—Turnbuckle to Crank	4
24	4117612	Crank Assembly	1
	4117612-1	Crank Assembly	1
	AN24-50	Bolt	2
	AN320-4	Nut	2
	1118149	End Assembly	2
	AN316-6R	Nut	2
	2117962-3	Rod	2
	AN24-20	Bolt	2
	AN320-4	Nut	2
	AN25-22	Bolt	2
	AN320-5	Nut	6
	AN25-17	Bolt	2
	AN25-26	Bolt	2
25	2074410-6-8-15620	Cable—Crank to Turnbuckle	4
26	4117611	Crank Assembly	2
	AN24-38	Bolt	2
	AN320-4	Nut	18
	1118147	End Assembly	2
	AN316-5R	Nut	2
	2117962-1	Rod	2
	AN24-20	Bolt	2
	AN24-22	Bolt	2
	AN24-17	Bolt	4

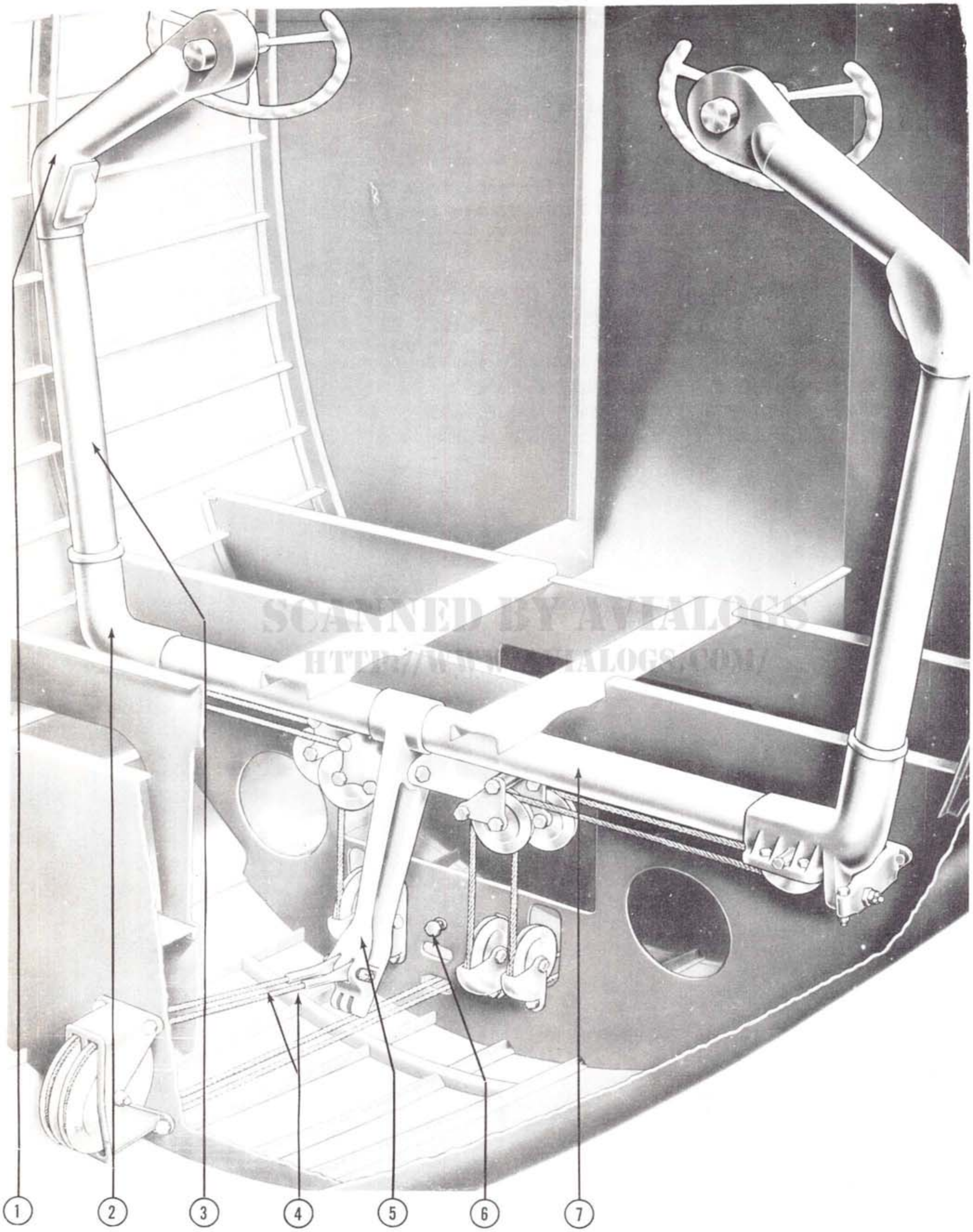


Figure 333—Control Column Installed

KEY TO FIGURE 333

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	4117124	Elbow	2
	1117117	Cover Plate (at Elbow)	2
	1117112	Cover Plate (at Top of Column)	2
2	4117121	Elbow	2
3	2117191	Tube	2
4	2074410-7-8-10328	Cable Assembly	Ref
5	4117366	Horn Assembly	1
6	1118271	Bumper Stop	1
	110242-4-20H	Bolt	1
	AN316-4R	Nut	1
7	117116	Tube	1

adjustment, and checking of the ailerons in the field with or without a tensiometer (cable tension measuring device). The procedure may be used to correct conditions such as improper travel of the ailerons, lack of synchronization between the aileron control mechanisms and the ailerons, and improper tension of the aileron control cables.

a. Open the aileron master differential horn access cover (figure 8) from the bottom side of the center wing section.

b. Open the aileron control cable and bellcrank covers (figure 8) on the under side of the outer wing panels.

c. Secure the aileron master differential horn in the neutral position, that is, with the horn arm lying in a fore and aft position. This is accomplished by inserting two blocks of wood (figure 337) between the aft end of the horn arm and the corners of the lower web.

d. Check the control wheels in the pilots' compartment for neutral position. (The center spokes must be vertical.) If the wheels are not synchronized with the master differential horn, compensate by adjusting the turnbuckles (figure 335) located beneath the companionway floor. Cable tension can be maintained during adjustment by tightening the one turnbuckle the same number of turns the other is loosened.

e. Check all cables extending between the differential crank and the control wheels for proper tension. If the instruments are available, use a tensiometer and thermometer in accordance with the cable rigging chart. (See figure 336.)

f. If instruments are not available, check cable tensions as follows:

(1) Check security of the blocks being used to hold the master differential horn in the neutral position.

(2) Exert normal pressure upon the control wheel in both directions. If tension is not immediately felt, the cables are too loose and a slight tightening of all aileron turnbuckles (figure 335) under the companionway floor will be necessary.

CAUTION

Be sure that the aileron turnbuckles are adjusted so that the aileron servo unit (figure 335) is in the neutral position when the ailerons are in neutral. (The shaft will project an equal distance from each end of the servo unit.)

(3) Remove the blocks from the master differential horn.

(4) Turn the control wheels the full distance in both directions. The control wheels should rotate freely without noticeable binding or grinding of the chains on the sprocket wheels inside the control columns. If binding or grinding occurs, the cables are rigged too tightly and a slight loosening of all five turnbuckles beneath the companionway floor will be necessary. The servo unit should not bottom on either end when rotating the wheel in both directions.

g. Replace the blocks which hold the master differential horn in neutral and proceed as follows to check synchronization of the aileron actuating cranks with the master differential horn:

(1) Remove the outboard bell crank actuating rod (figure 338) from the airplane by detaching the clevis bolt which attaches the rod to the bell crank, loosening the jam nut on the aft end of the rod, and unscrewing the rod from the eyebolt.

(2) Disconnect the inboard bell crank actuating rod from the bell crank. It will not be necessary to disconnect the aft end of this rod.

CAUTION

To prevent possible damage to the fabric in the leading edge of the aileron, support the aileron in some manner so that the trailing edge will not drop down when the actuating rods are disconnected.

(3) Check the tension of the cables extending from the master differential horn to the inboard bell crank and, if necessary, make an adjustment in accordance with the cable rigging chart. (See figure 336.) Maintain the forward and aft arm of the bell crank in a position parallel with that of the master differential horn.

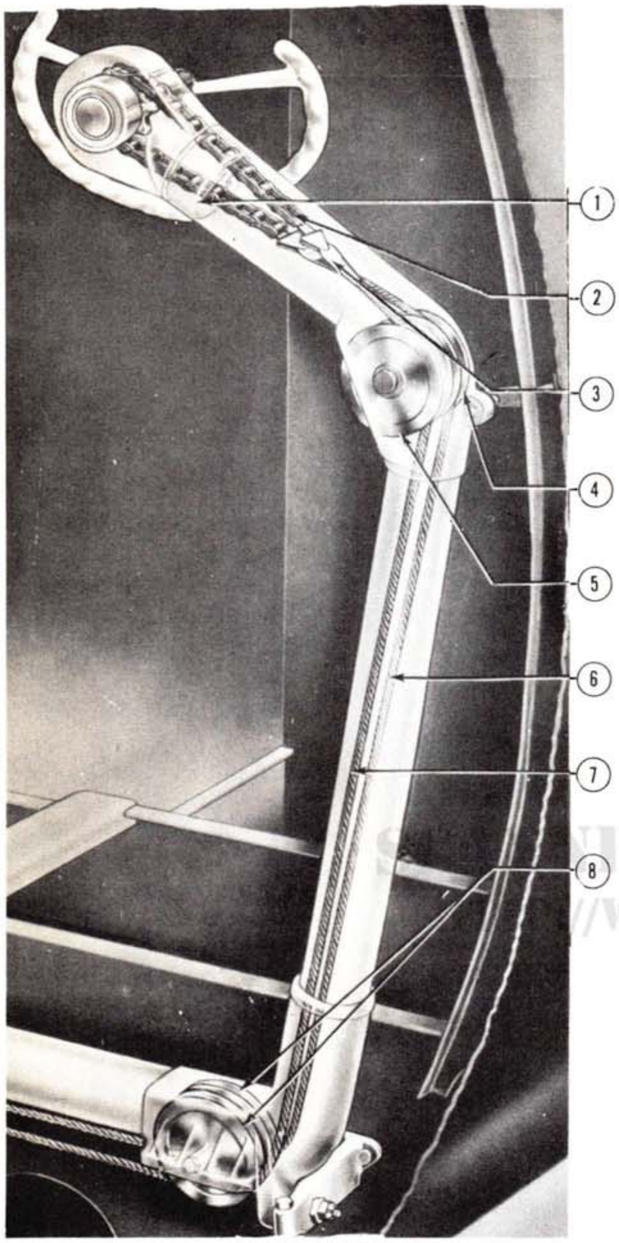


Figure 334—Pilot's Control Column Rigging (Left-Hand)

(4) Reconnect the inboard actuating rod.

(5) Check the aileron for the neutral or "droop" position. (See figure 339.) This must be 7/8 inch ± 1/8 inch below the trailing edge of the wing, measured at the inboard tip of the aileron. If adjustment is necessary, lengthen or shorten the inboard bell-crank actuating rod. One complete turn of the rod raises or lowers the aileron one-fourth of an inch.

(6) Remove the blocks from the master differential horn and the support from the aileron; check the aileron throw (figure 340) by revolving one of the control wheels. Measuring from trailing edge of the wing with aileron on trail position, up throw must be 13 inches ± 1/8 inch, or 27 degrees ± 1/2 degree. Down throw is 8 inches ± 1/2 inch, or 18 degrees ± 2 degrees.

(7) If the aileron throw is too short, loosen the aft cable and tighten the forward cable. If the throw exceeds requirements, loosen the forward cable and tighten the aft.

(8) If the aileron throw is changed, it will be necessary to readjust for the neutral position by revolving the inboard bell crank actuating rod.

(9) Check the tension of the aileron cables between the inboard and outboard bell cranks and, if necessary, make an adjustment at the turnbuckles.

(10) Replace the outboard actuating rod. Adjust the cable lengths and the rod length so that the clevis bolt rides free, without binding, when the aileron is placed in the "UP," "DOWN," and "NEUTRAL" positions.

(11) Safety all turnbuckles.

(c) CONTROL WHEEL MECHANISM.
(See figure 341.)

1. DESCRIPTION.—The control wheel mechanism installed in each side of the dual-control column consists primarily of a wheel fabricated of aluminum alloy and covered with hard rubber, a bronze sprocket and shaft, a roller chain to which two stops are attached, and two control cables. The stops, which strike a slotted plate in the control column elbow, limit the travel of the control wheel.

(For cable manufacturing information refer to section IX.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	1142434	Stop Plate	2
2	1117024	Stop	4
	1117023	Bolt	4
	AN320-5	Nut	4
3	No. 66	Diamond Roller Chain	2
4	2117120	Pulley (Dural)	2
5	AN210-4A	Pulley (Micarta)	2
6	2074410-7-0-12228	Left Column	1
	2074410-7-0-9428	Right Column	1
7	2074410-4-0-9212	To Servo Unit (LH Column Only)	1
	2074410-7-0-9428	(RH Column)	1
8	AN210-4A	Pulley	4

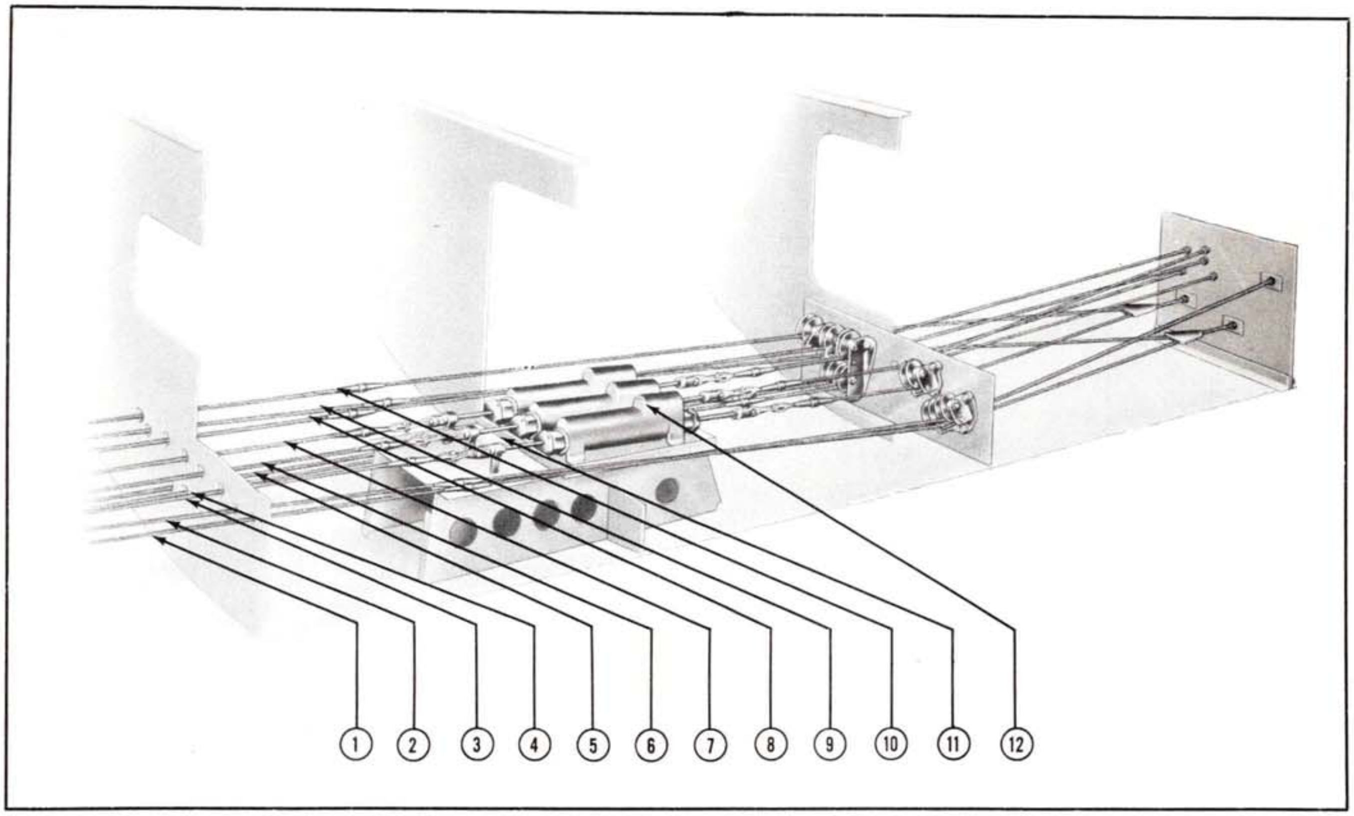


Figure 335—Control Cables at Servo Unit

1. LH Rudder Cable
2. LH Outer Aileron Cable
3. RH Inner Aileron Cable
4. LH Lower Elevator Cable
5. RH Lower Elevator Cable
6. RH Rudder Cable
7. LH Upper Elevator Cable
8. RH Upper Elevator Cable
9. LH Inner Aileron Cable
10. RH Outer Aileron Cable
11. Link (1117831) and Clevis (139187)
12. Servo Unit (Simplified View)

2. REMOVAL AND DISASSEMBLY.

a. CONTROL WHEEL. *(See figure 341.)*

(1) Install the surface locks on the ailerons.

(2) Disconnect the control cables at the turnbuckles under the companionway floor.

(3) Remove the cap screwed to the top of the column.

(4) Cut the safety wire and remove the six bolts from the cap through which the wheel shaft passes.

(5) Lift the roller chain until the chain is free of the bronze sprocket.

(6) Remove the complete wheel and sprocket assembly by pulling aft on the wheel.

CAUTION

Do not allow the chain and cable to drop down into the control column.

b. ROLLER CHAIN. *(See figure 334.)*

(1) Install the surface locks on the ailerons.

(2) Disconnect the aileron control cables at the turnbuckles under the companionway floor.

(3) Remove the cap from the top of the control column.

(4) Remove the control wheel and sprocket assembly as described in paragraph 12.*c.*(1)(*c*)2.a.

(5) Lift the chain until the stops strike the stop plate, and then give the chain a quarter turn so that the stops can be drawn through the stop plate opening.

(6) Fasten the cables to the column head so that they will not drop down into the column when they are disconnected from the chain.

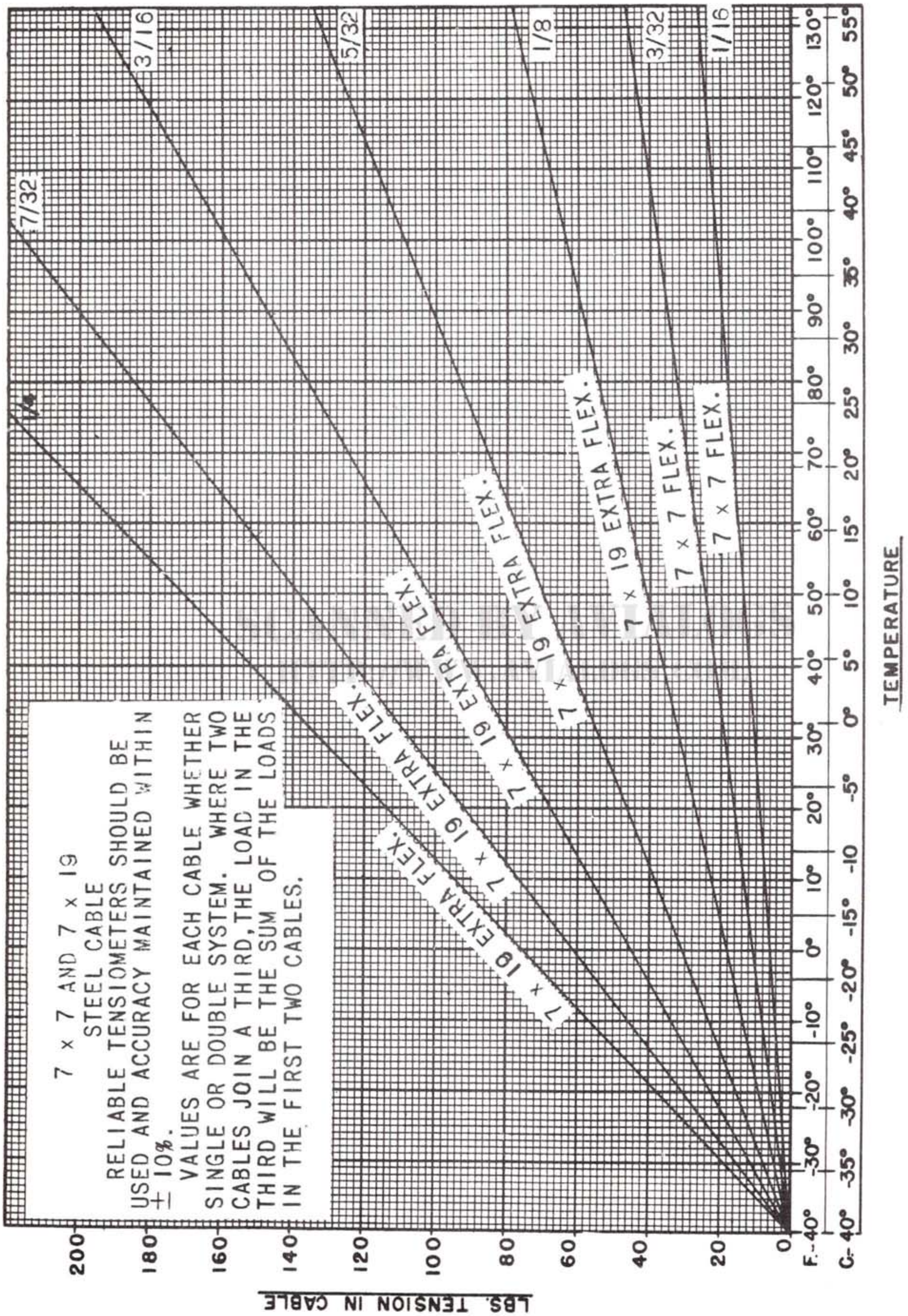
(7) Disconnect the chain from the cable by removing the two bolts.

(8) Lift the chain out of the column head.

Note

The master link in the roller chain is attached to the other links by means of rivets.

c. CHAIN AND CABLE COMPLETE. *(See figure 334.)*



7 x 7 AND 7 x 19
STEEL CABLE

RELIABLE TENSIOMETERS SHOULD BE USED AND ACCURACY MAINTAINED WITHIN ± 10%.

VALUES ARE FOR EACH CABLE WHETHER SINGLE OR DOUBLE SYSTEM. WHERE TWO CABLES JOIN A THIRD, THE LOAD IN THE THIRD WILL BE THE SUM OF THE LOADS IN THE FIRST TWO CABLES.

Figure 336—Cable Rigging Chart

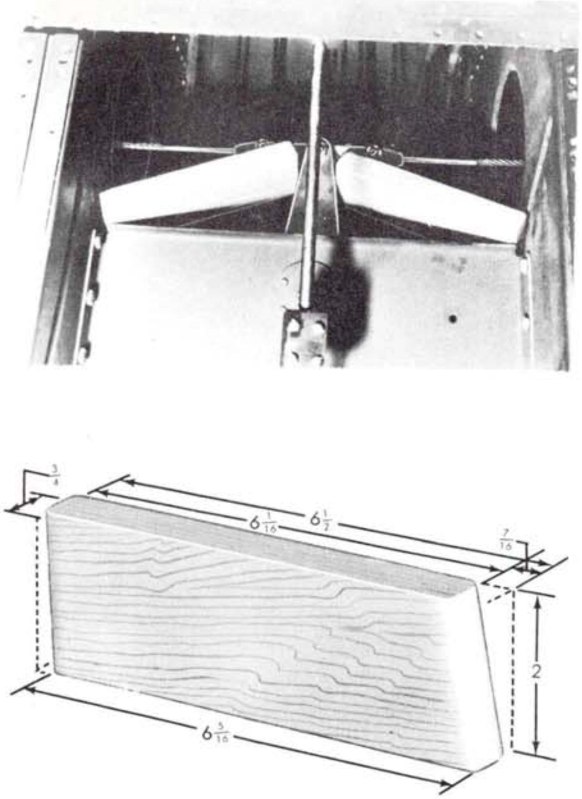


Figure 337—Use of Wood Blocks to Secure Aileron Master Differential Horn in Neutral

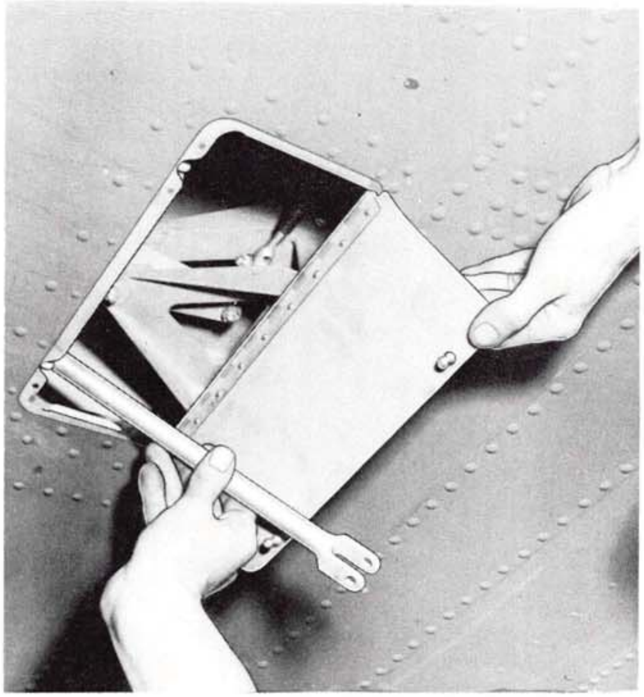


Figure 338—Removal of Aileron Outboard Bell Crank Actuating Rod

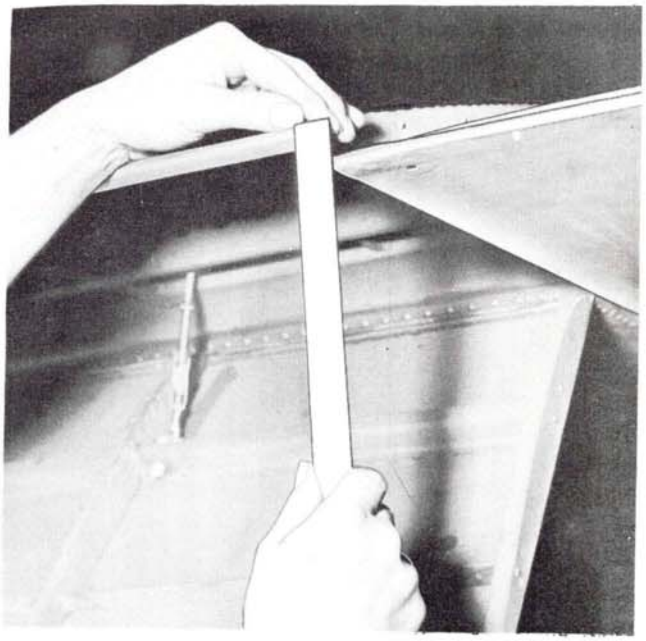


Figure 339—Aileron Droop Measurement

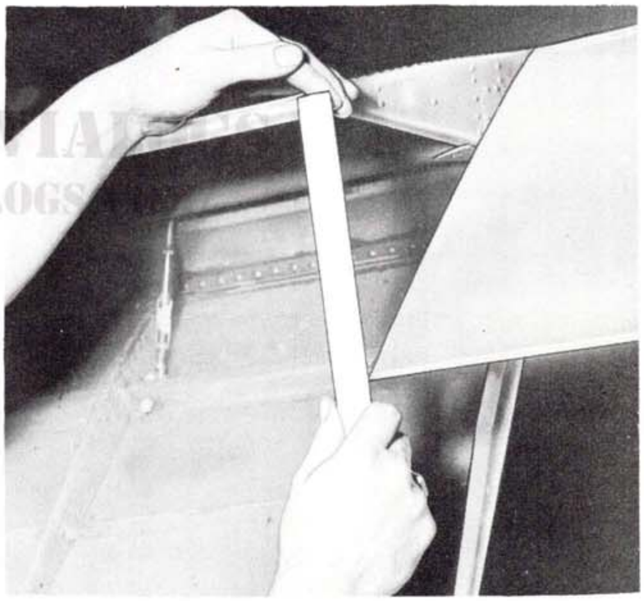


Figure 340—Aileron Throw Measurement

(1) Install the surface locks on the ailerons.

(2) Disconnect the aileron cables at the turnbuckles under the companionway floor. Attach guide lines to the turnbuckles to facilitate replacement of the cables in the column.

(3) Remove the pulleys from the brackets forward of the turnbuckles.

(4) Remove the pulleys, located beneath cover plates, from the two elbows of the control column.

(5) Remove the control wheel as described in preceding paragraph 2.a.

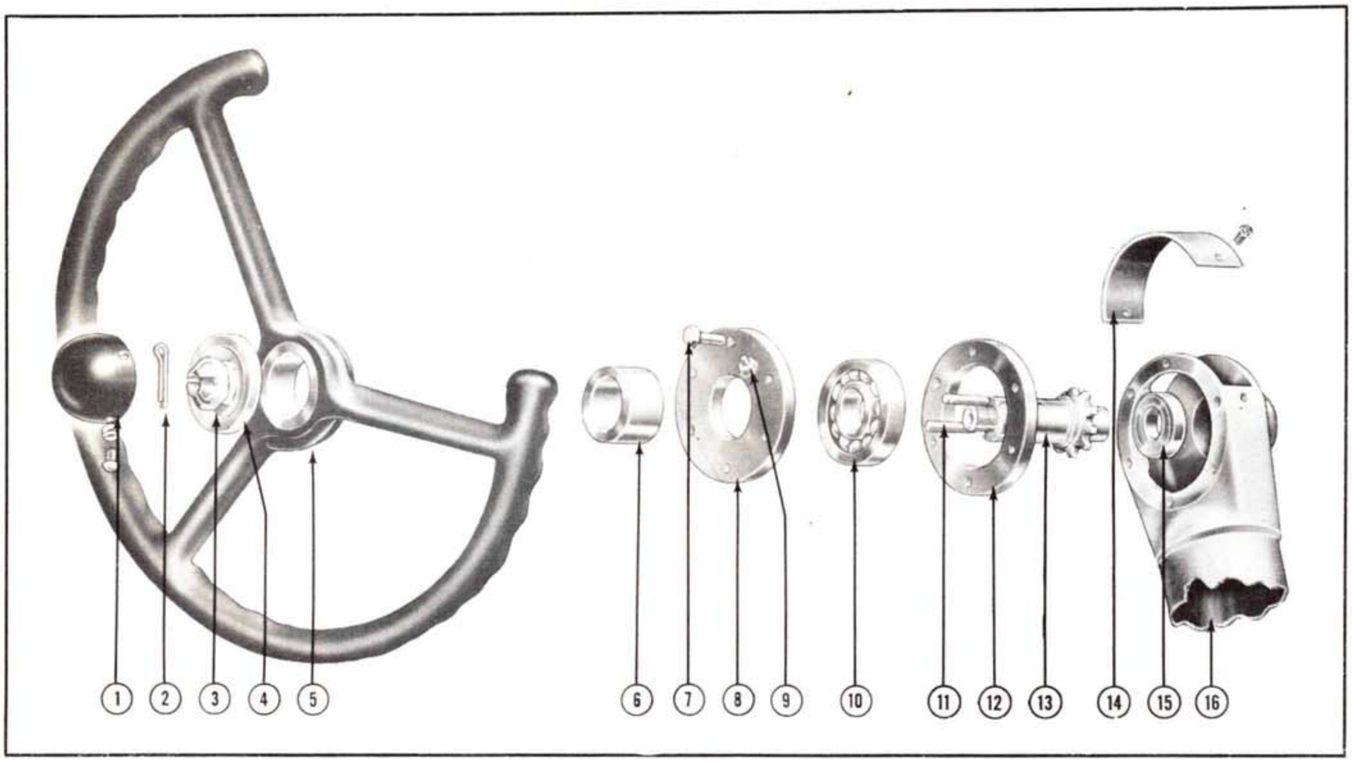


Figure 341—Control Wheel—Exploded View

Item	*Part No.*	*Part Name*	*No. Req Per Assembly*
1	1117110	Cap	1
	AN515-4-4	Screw	3
	AN935-4	Washer	3
	AN960-4	Washer	3
2	AN380-3-3	Cotter	1
3	AN310-8	Nut	1
4	1117111	Washer	1
5	5117125	Wheel	1
6	1117113	Sleeve	1
7	132100-4-7A	Bolt	6
	AN960-D416	Washer	6
	AAF995C40-12	Wire	1
8	1117114	Cap—Control Column Head Bearing	1
9	47	Zerk	1
10	205SF	Ball Bearing	1
11	110845	Key	2
12	1117115	Housing	1
13	2117119	Sprocket	1
14	1117112	Plate	1
	AN520-10-5	Screw	2
	AN935-10	Lock Washer	2
15	203SF	Ball Bearing	1
16	4117122	Head Assembly	1

(6) Remove the cap from the control column head.

(7) Lift the chain, give it a quarter turn to free the stops and pull chain and cable assembly out of the control column.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replace worn or damaged sprockets, bearings, or roller chains. Replace the control cables if they are frayed to the point where more than six wires are broken in any 1-inch length.

4. ADJUSTMENTS.—All adjustments in the travel of the aileron control wheel and cables must be

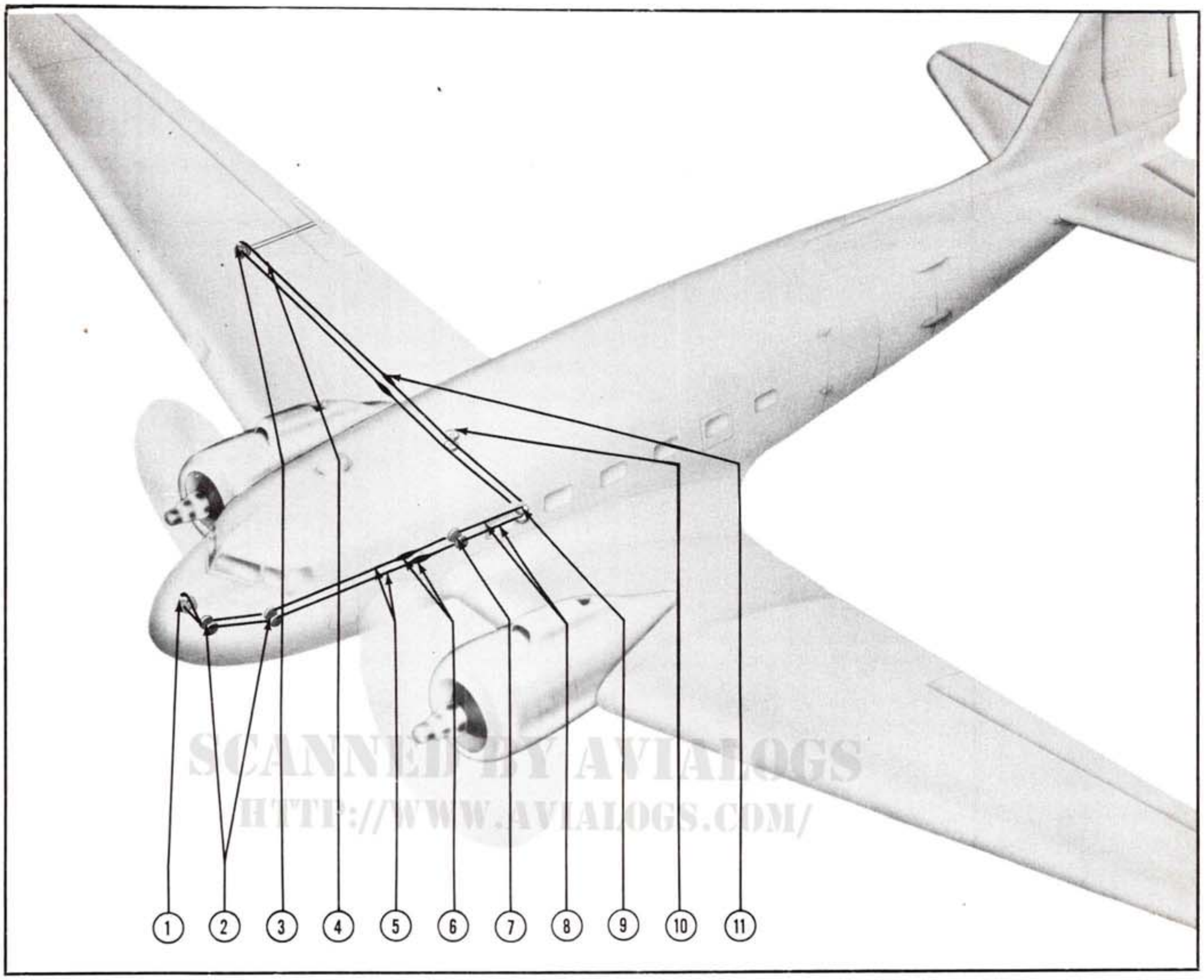


Figure 342—Aileron Tab Controls

(For cable manufacturing information refer to section IX.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2118197	Tab Operating Drum	1
	AN4-22	Bolt	2
	AN310-4	Nut	2
	2117755	Actuating Rod Assembly	1
	111904-3-032	Bolt	1
	AN320-3	Nut	2
	1117756	Link	1
	111904-3-024	Bolt	1
2	2074406-4-4-32330	Cable—Outer Wing	1
3	2116158	Drum in Pedestal	1
4	AN210-2A	Pulley	4
5	2115350-3	Pedestal Drum Cable	1
6	AN155-8S	Turnbuckle Barrel	2
7	AN210-1A	Pulley	2
8	2074406-4-5-28616	Cable in Fuselage	2
9	AN210-2A	Pulley	2
10	AN210-1A	Pulley	1
11	AN155-8S	Turnbuckle Barrel	2

made by regulating the cable turnbuckles. The aileron control wheel stops (figure 334) are not adjustable.

5. INSTALLATION.—Reverse the removal procedure when installing the control wheel mechanism; observing the following precautions:

a. Make certain that the roller chain has been fitted on the proper sprocket tooth in the control column. This can be checked by turning the control wheel to the extreme right or left. The spoke of the wheel should come around even with the column elbow and the roller chain stop should strike the control column head stop. When the wheel is in the neutral position, the center spoke should be vertical.

b. Take care that the cables do not become crossed when they are being installed in the control column. On the pilot's side, the shorter cable with the left-hand thread is strung into the column through the forward channel, passed over the fibre pulley in the elbow, and is directed to the top of the sprocket. The longer cable with the right-hand thread is strung over the metal pulley which always is installed on the aft side of the elbow with the short flange facing the fibre pulley. From the metal pulley the longer cable is directed to the under side of the sprocket. On the copilot's side of the column the aft cable is strung over the metal pulley and is directed to the under side of the sprocket. On both sides of the column the bolts which attach the roller chain to the cable are installed with the heads facing each other.

c. Adjust cable tension in accordance with the cable rigging chart. (See figure 336.)

6. TEST AFTER INSTALLATION.—Check the control column wheel for proper travel.

(2) AILERON TAB CONTROL. *(See figure 342.)*

(a) DESCRIPTION. — The right aileron is equipped with a movable trim tab (figure 325) which is operated by a crank (figure 343) located on the control pedestal. Clockwise rotation of the crank lowers the tab, forcing the aileron up and the wing down when the airplane is in flight. Counterclockwise rotation of the control crank raises the tab, forcing the aileron down and the wing up. A graduated dial (figure 343),

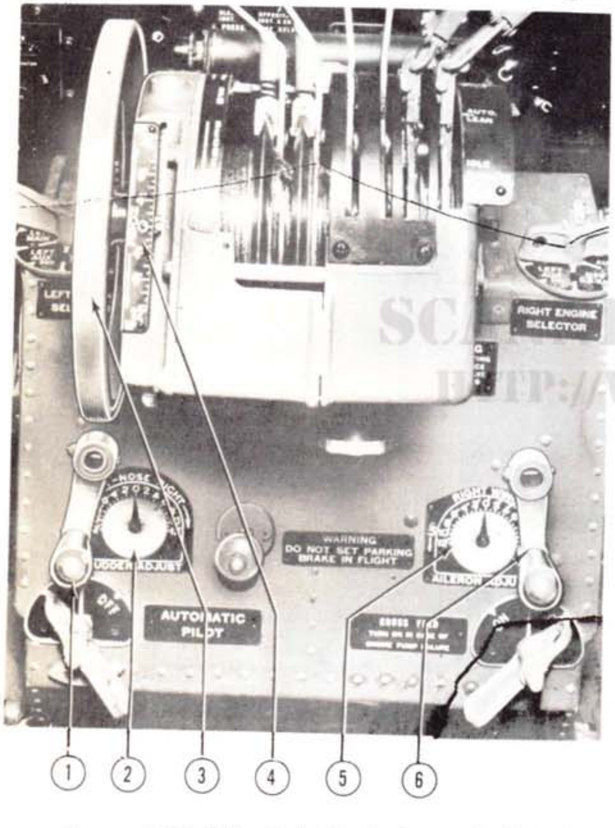


Figure 343—Trim Tab Controls on Pedestal

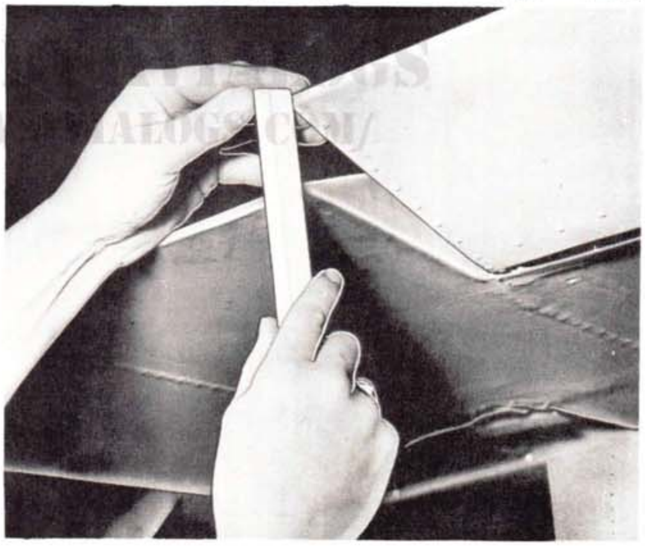


Figure 344—Aileron Trim Tab Throw Measurement

KEY TO FIGURE 343

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	1116178	Rudder Tab Control Crank	1
	080577	Handle	1
2	1116216	Rudder Tab Indicator Plate	1
3	2116127	Elevator Tab Control Hand Wheel	1
	AF365-D524	Nut	1
	AN288-404	Woodruff Key	1
4	1116196	Elevator Tab Control Indicator Plate	1
5	1116185	Aileron Tab Control Indicator Plate	1
6	1116178	Aileron Tab Control Crank	1
	080577	Handle	1

which indicates the effect of the tab movement on the lateral attitude of the airplane when it is in flight, is located beside the control crank. The tab control cables (figure 342) are wound around a drum on the control crank shaft within the pedestal and pass over a set of pulleys below the pilot's compartment floor. From this point the cables continue aft to the center wing section and outboard to the drum of the tab operating mechanism in the outer wing. The tab stops, consisting of cable lugs which strike fixed fair-leads, are located in the outer wing panel. They are not adjustable.

(b) ADJUSTMENTS. – To correct improper travel of the aileron trim tab, or lack of synchronization between the tab control in the pedestal and the tab, proceed as follows:

1. Obtain the proper cable tension by regulating the turnbuckles.

2. Open the inboard cable access door in the outer wing.

3. Manually line up the two fixed stops attached to the tab cables just outboard of the turnbuckles.

4. With the two stops lined up, the trim tab should be in the neutral position. If not, bring the tab to neutral by lengthening or shortening the tab actuating rod.

5. Check the tab for proper throw by pushing and pulling the cables until they are halted by the stops. If the tab throw is incorrect, adjust by loosening one turnbuckle and tightening the other. Correct throw, up and down, is 2 inches ± ⅛ inch, or 12-½ degrees ± ½ degree. (See figure 344.)

6. When the tab motion has been synchronized with the cable stops, check the indicator (figure 343) on the control pedestal for the zero position. If the pointer is in any position other than zero, reset the hand by loosening the screw in the center of the dial.

(3) ELEVATOR CONTROLS. *(See figure 345.)*

(a) DESCRIPTION.–Elevator movement is controlled by a conventional control column. (See figure 333.) The four elevator control cables are attached to a single horn (figure 333) on the control column torque tube. The elevator UP cables are routed directly aft from the horn to the automatic pilot servo unit (figure 335) where one of the cables is connected to the servo unit piston. From this point the cables are routed through the lower part of the fuselage to the empennage where they are attached to the upper arm of the elevator torque tube horn. The elevator DOWN cables are routed forward from the control column horn to two special pulleys (figure 333) and then aft to the empennage where they are attached to the lower arm of the elevator torque tube horn.

(b) ADJUSTMENTS.–Following is a procedure for the rigging, adjustment, and checking of the elevators in the field. The method may be used to correct improper throw of the elevators, lack of synchronization between the control column and the elevators, and incorrect tension of the elevator cables.

1. Remove the tail cone.

2. With the elevators in the "DOWN" position, adjust cable tension in accordance with the cable rigging chart. (See figure 336.) Add approximately 10 pounds tension (three points on the tensiometer) to each of the lower elevator cables.

3. Adjust the stop (figure 333) on the bulkhead aft of the control column horn to provide a clearance of from 1 to 1-½ inches between the control column and the instrument panel when the column is in the forward position.

4. Adjust the "DOWN" throw of the elevators (figure 346) to 8 inches ± ⅛ inch, or 20 degrees ± ½ degree, by loosening the lower pair of turnbuckles (figure 326) in the aft section, and tightening the upper pair. Set the rubber cushion stop (figure 328) so that the elevator horn compresses it about ¼ inch.

5. Adjust the "UP" throw of the elevators to 12 inches ± ⅛ inch, or 30 degrees ± ½ degree, by turning the two stop bolts (figure 347) on the control column, and the cushion stop in the aft section. Allow a clearance of ¼ inch between the stop bolts on the control column and the fixed stops located on each side of the fuselage, when the column is in the aft position and the elevator horn in the aft section is compressing the cushion stop about ¼ inch.

6. Secure all turnbuckles with No. 18 steel safety wire.

(c) CONTROL COLUMN. *(See figure 333.)*

1. DESCRIPTION.–The forward and aft movement of the control column controls the travel of the elevators. The control column is constructed of aluminum-alloy tubes and castings. The torque tube (figure 333), which forms a part of the assembly, is fabricated of steel. The forward travel of the control column is limited by an adjustable stop located on the fuselage structure in the path of the torque tube horn. Bolts installed on the upper elbows of the column strike fixed stops (figure 347) in the pilots' compartment to limit the aft movement of the column.

2. REMOVAL.

a. Place the surface locks on the ailerons and the elevators.

b. Remove the seats of the pilot and copilot.

c. Remove the flooring in the pilot's compartment and the companionway, aft to station 136½.

d. Remove the landing gear mechanical latch control (figure 128) attached to the left-hand floor channel. Disconnect the mechanical latch cable at the mechanical latch torque tube (figure 127) installed below the floor beams aft of station 86.

e. Remove the two floor channels in the pilot's compartment.

f. Remove the eight aileron guide pulleys installed beneath the control column torque tube.

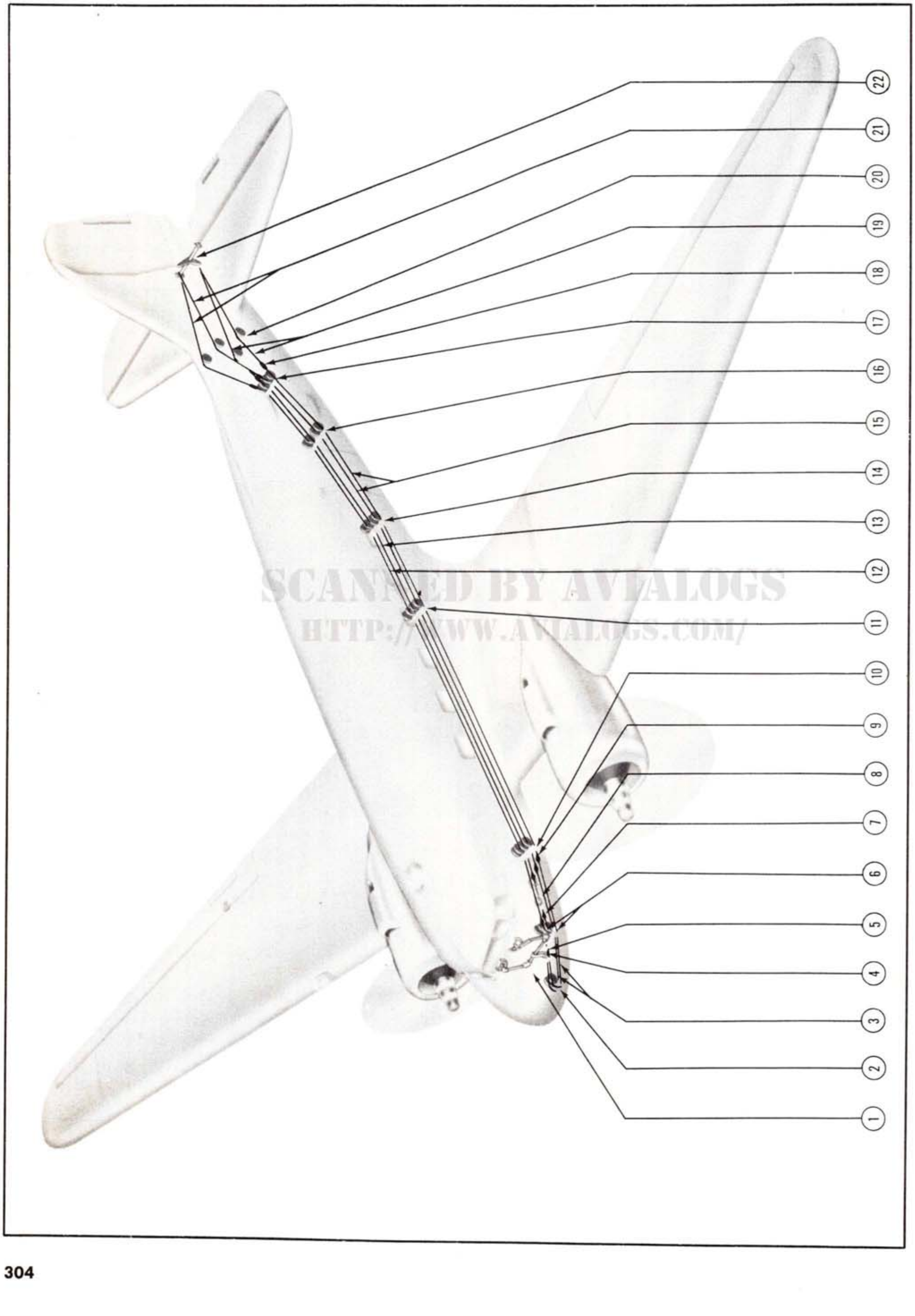

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

Figure 345—Elevator Controls

KEY TO FIGURE 345

(For cable manufacturing instructions refer to section IX.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	5110598	Control Column Assembly	1
2	AN210-5A	Pulley	2
3	2074410-7-8-10328	Cable—Lower LH and RH	2
4	2074410-7-8-5928	Cable—Upper RH	1
5	2074410-7-8-2916	Cable—Upper LH	1
6	AN210-3A	Pulley	4
7	AN155-46S	Turnbuckle Barrel	2
8	See figure 335	Servo Unit	1
9	AN155-46L	Turnbuckle Barrel	3
10	AN210-3A	Pulley	4
11	AN210-3A	Pulley	4
12	2074410-6-6-48004	Cable—Upper RH	1
13	2074410-4-6-47904	Cable—Upper LH	1
14	AN210-3A	Pulley	4
15	2074410-6-6-48516	Cable Lower LH and RH	2
16	AN210-3A	Pulley	4
17	AN210-4A	Pulley	4
18	AN155-46L	Turnbuckle Barrel	4
19	2074410-7-9-12628	Cable—Lower LH and RH	2
20	AN210-4A	Pulley	4
21	2074410-7-9-15516	Cable—Upper LH and RH	2
22	5115163	Elevator Horn	1

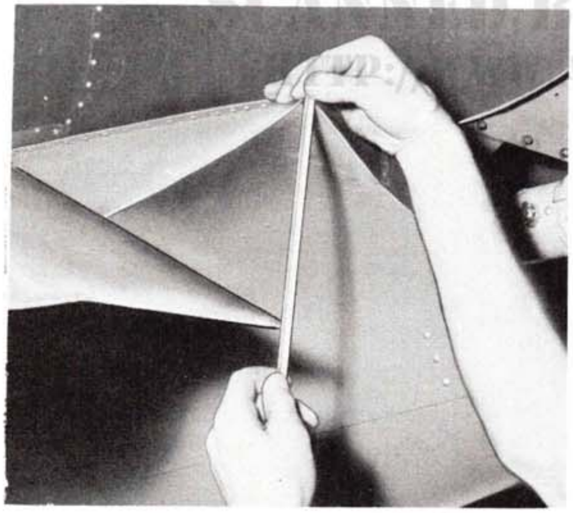


Figure 346—Elevator Throw Measurement

g. Disconnect the aileron cables at the turnbuckles (figure 335) located beneath the floor beams aft of the pilot's compartment. Secure the cables to prevent loss of rigging.

h. After disconnecting the aileron cables, turn the control column wheels to the left or right extreme and tie them to the column. This will secure the chains on the sprockets in the control column heads so that a chain cannot jump on the sprocket and throw one wheel out of synchronization with the other.

i. Detach the two elevator cables from the elevator horn.

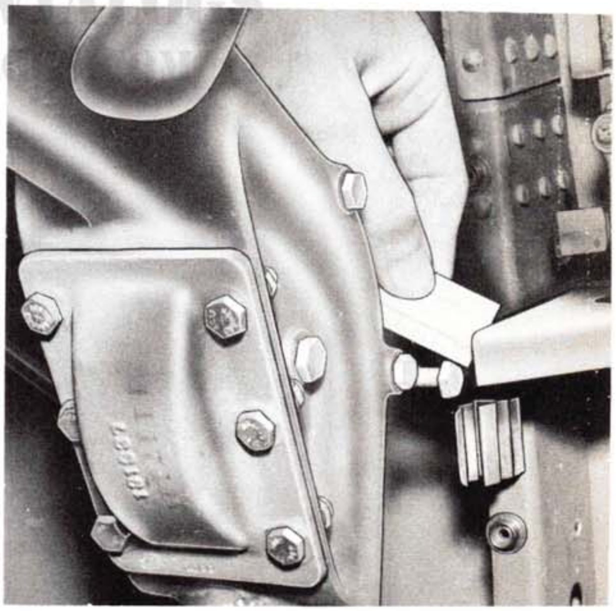


Figure 347—Stop Clearance on Control Column

j. Remove the canvas boots clamped to the bottom elbows of the column to keep dust out of the mechanism.

k. Remove the three hinge bolts (figure 333) which attach the control column assembly to the fuselage structure.

l. Lift out the entire control column assembly.

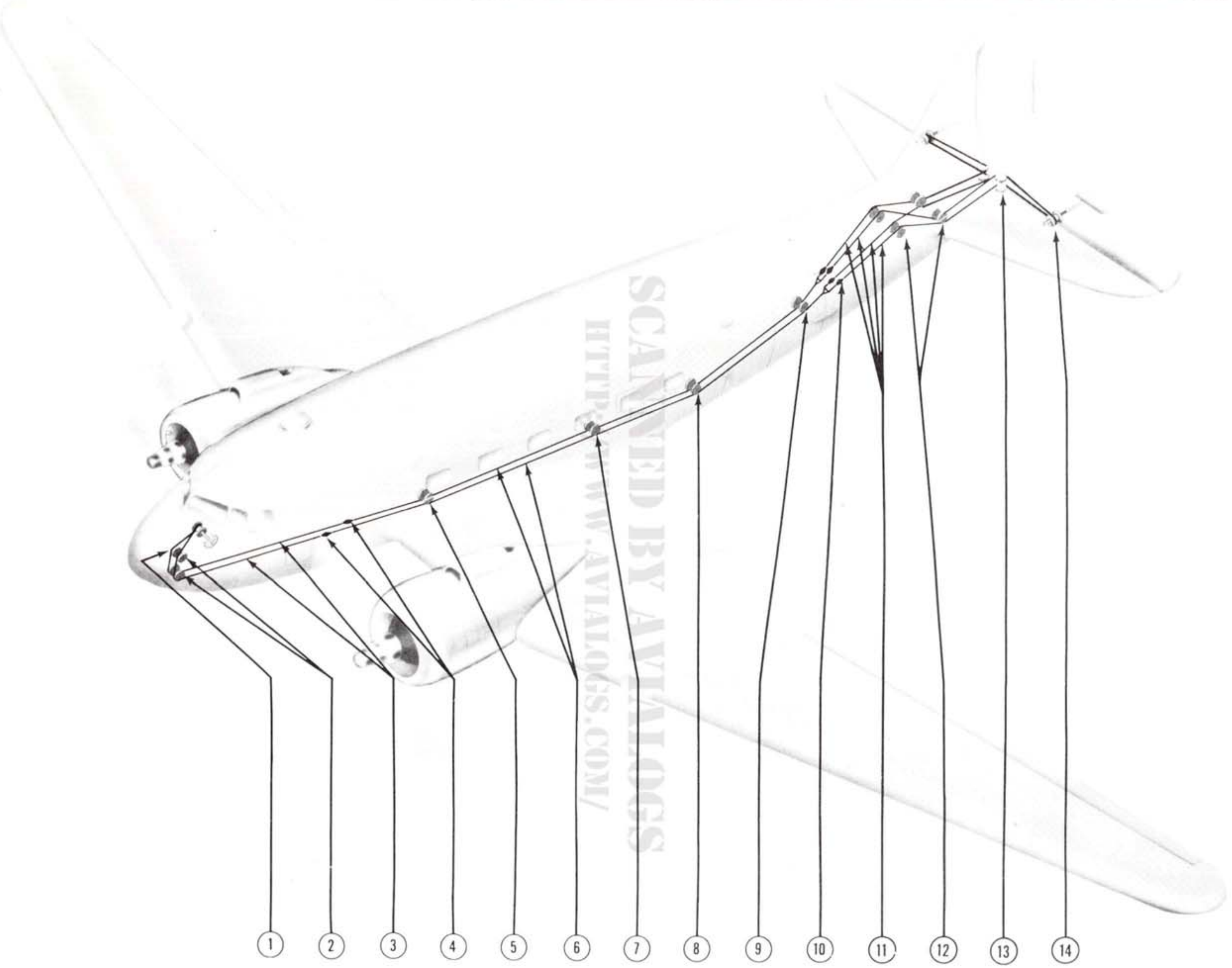

1
2
3
4
5
6
7
8
9
10
11
12
13
14

Figure 348—Elevator Tab Controls

KEY TO FIGURE 348

(For cable manufacturing information refer to section IX. For rigging detail see figure 326.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2116126	Trim Tab Drum	1
2	AN210-2A	Pulley	2
3	3115353-1	Cable Assembly at Pedestal	1
4	AN155-16L	Turnbuckle Barrel	2
5	AN210-1A	Pulley	2
6	2074407-6-9-47912	Cable Assembly	2
7	AN210-1A	Pulley	2
8	AN210-2A	Pulley	2
9	AN210-2A	Pulley	2
10	AN155-8S	Turnbuckle Barrel	4
	1115743	Link	2
11	2074406-4-4-497	Cable Assembly Aft	2
12	AN210-2A	Pulley	8
13	AN210-3A	Pulley	4
14	271044	Drum	2
	2116937	Actuating Rod Assembly	2

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. A control column which has encountered structural damage shall be replaced.

b. Replace worn or broken sprockets, bearings or pulleys.

4. INSTALLATION. – Reverse the removal procedure.

5. ADJUSTMENTS.—For instruction on the adjustment of the control column stops refer to paragraph 12.*c*.(3)*(b)*, this section. For instructions on the rigging of the aileron cables in the control column, refer to paragraph 12.*c*.(1)*(b)*, this section.

(4) ELEVATOR TAB CONTROLS. *(See figure 348.)*

(a) DESCRIPTION.—Elevator trim tab motion is controlled by a wheel (figure 343) installed on the control pedestal. Forward rotation of the wheel raises the tab and forces the airplane nose down when the airplane is in flight. Rearward rotation of the wheel lowers the tab and raises the nose of the airplane when it is in flight. A graduated dial (figure 343) which indicates the effect of the tab movement on the longitudinal attitude of the airplane when it is in flight, is located on the control pedestal beside the tab control wheel. The tab control cables are wound around a drum on the control wheel shaft within the pedestal and extend downward to pulleys located below the pilots' compartment floor. The cables continue aft to the empennage where they diverge into each elevator and wind around the drums of the tab operating mechanisms.

(b) ADJUSTMENTS.

1. Adjust cable tension at the turnbuckles in accordance with the cable rigging chart. (See figure 336.) Tighten the forward turnbuckles until all threads are covered and then add 12 turns.

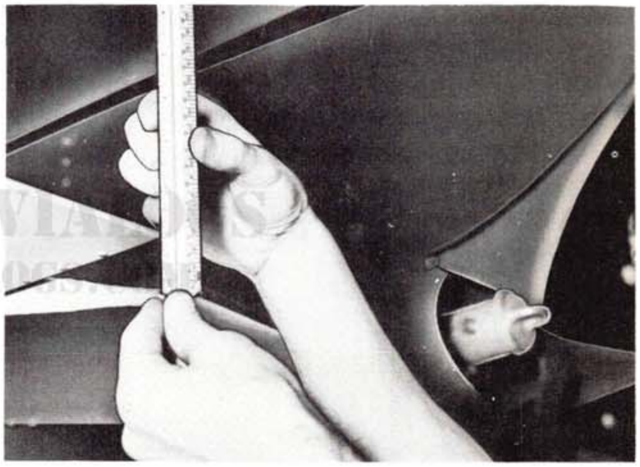


Figure 349—Elevator Tab Throw Measurement

2. Put the tabs in the neutral position and set the indicator to "ZERO."

3. Check the tabs for proper movement. (See figure 349.) Correct throw, UP or DOWN, is 1-⅝ inches ± ⅛ inch, or 12 degrees ± ½ degree.

4. If tab movement is incorrect the difficulty can be traced to improper cable lengths. Travel of the cables is limited to the proper distance by stop lugs which are soldered to the cables in the fuselage below the lavatory bulkhead. The lugs strike fixed fair-leads on the fuselage structure.

5. Secure all turnbuckles with steel safety wire.

(5) RUDDER CONTROLS. *(See figure 350.)*

(a) DESCRIPTION.—Rudder movement is controlled by rudder pedals (figure 351) which are adjustable forward and aft to accommodate pilots of varying stature. The pedals are connected to two torque tubes (figure 351); to each tube a horn (figure 351) is

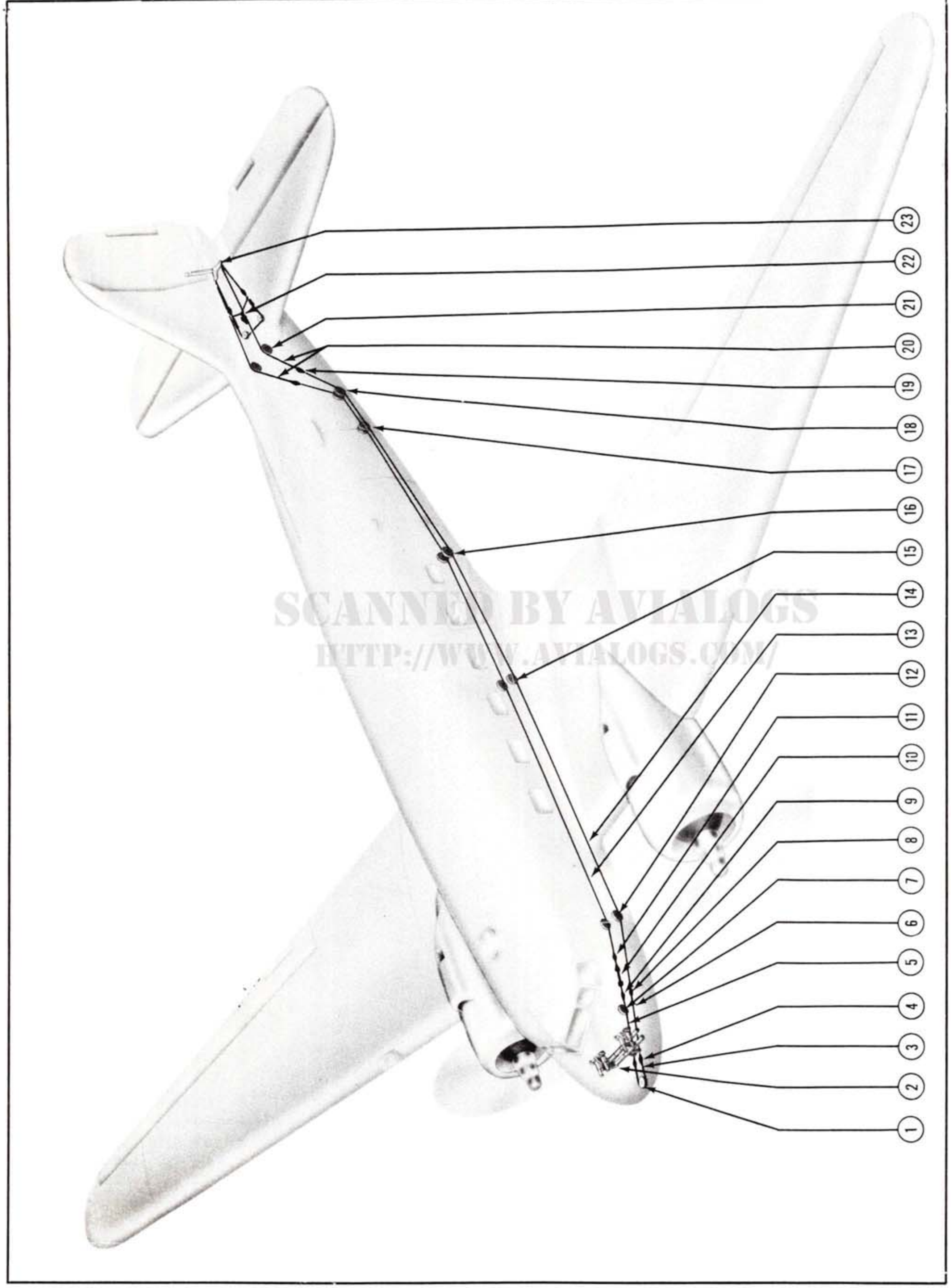

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

Figure 350—Rudder Controls

KEY TO FIGURE 350

(For cable manufacturing instructions refer to section IX.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2118306	Pulley	1
2	(See figure 351)	Rudder Pedal Assembly	Ref
3	2074410-4-8-3412	Rudder Bus Cable	1
4	AN155-46S	Turnbuckle Barrel	2
5	2074410-4-8-5024	RH Rudder Cable	1
6	2074410-7-8-5712	LH Rudder Cable	1
7	AN210-3A	Pulley	1
8	AN155-46S	Turnbuckle Barrel	1
9	AN155-46L	Turnbuckle Barrel	1
10	(See figure 335)	Servo Unit	Ref
11	AN155-46S	Turnbuckle Barrel	1
12	AN210-3A	Pulley	2
13	2074410-4-6-50404	RH Rudder Cable	1
14	2074410-6-6-53024	LH Rudder Cable	1
15	AN210-3A	Pulley	2
16	AN210-3A	Pulley	2
17	AN210-3A	Pulley	2
18	AN210-4A	Pulley	2
19	AN155-46L	Turnbuckle Barrel	2
20	2074410-7-8-11208	LH and RH Rudder Cable	2
21	AN210-4A	Pulley	2
22	(See figure 350)	Rudder Stop Assembly	Ref
23	5118056	Rudder Horn	1

attached. Cables extend aft from the horns to the empennage, where they connect to the rudder torque tube. Rudder pedal action is synchronized by a bus cable (figure 351) which extends forward from the rudder pedal torque tube horns to a special pulley. Rudder movement is limited by a rudder stop cable assembly (figure 352) located in the fuselage aft section. The assembly, which is separate from the rudder control system, extends from a bracket (figure 352) on the top surface of the horizontal stabilizer to the rudder torque tube horns. Movement of the rudder pedals is limited by the horns, on which there are adjustable bolts which strike against stops on the fuselage structure.

(*b*) ADJUSTMENTS.

1. Be sure that the rudder pedals are in the full aft adjustment position. (The ends of the splined shafts will be flush with the forward side of the arms.)

2. Place the rudder in the neutral position and secure it with the surface control lock.

3. Obtain proper cable tension by adjusting the rudder cable turnbuckles.

4. Align the rudder pedals by means of the turnbuckles in the aft section, tightening one turnbuckle and loosening the other.

5. Adjust the front bumper stops (figure 351) on the rudder pedal horns to obtain a rudder throw of 27 inches, right and left.

6. Shorten the rudder cables (figure 352) in the aft section to obtain a final rudder throw of 26½ inches ± ¼ inch. (See figure 354.)

(6) RUDDER TAB CONTROLS. *(See figure 353.)*

(*a*) DESCRIPTION. – The rudder trim tab movement is controlled by a crank (figure 343) on the control pedestal. Clockwise rotation of the crank turns the tab to the left, forcing the rudder to the right when the airplane is in flight. Rotation of the crank to the left turns the tab to the right. A graduated dial (figure 343) shows the effect of tab operation on the directional attitude of the airplane. The tab control cables are wound around a drum on the control crank shaft in the pedestal. The cables are routed over pulleys below the pilots' compartment floor and aft of the rudder where they wind around the drum (figure 356) of the tab operating mechanism. Rotation of the crank causes the drum to turn and impart a forward or aft movement to the tab connecting tube.

(*b*) ADJUSTMENTS.

1. Adjust cable tension at the turnbuckles (figure 353) in accordance with the cable rigging chart. (See figure 336.)

2. Put the tab in the neutral position and set the tab indication at "ZERO."

3. Check the tab for proper movement. (See figure 355.) Correct throw of the tab, right and left, is 2-¾ inches ± ⅛ inch, or 12 degrees ± ½ degree.

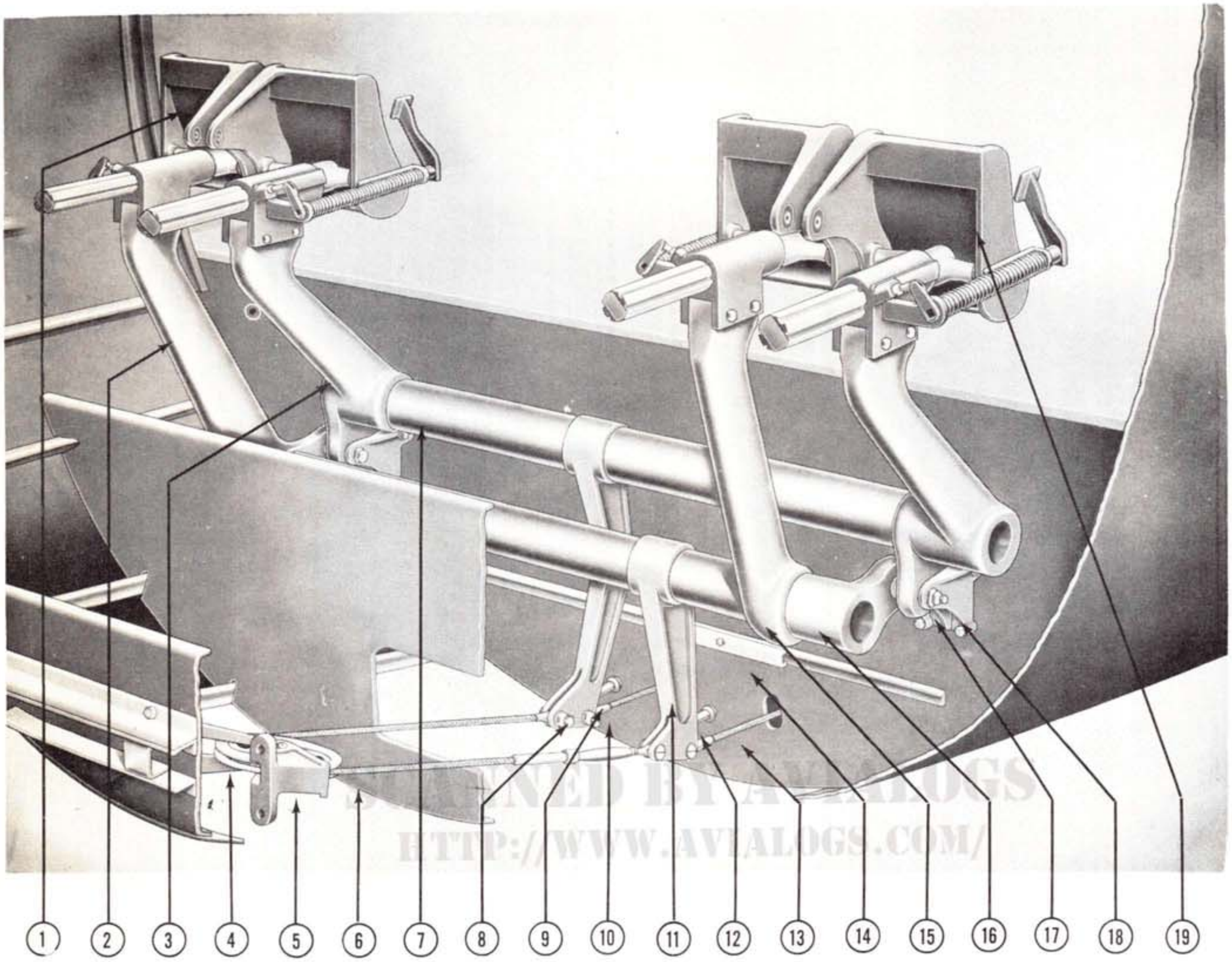


Figure 351—Rudder Pedal Mechanism

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	5118930-1	Rest Assembly	2
	AN3-21	Bolt	4
	AN310-3	Nut	4
2	5118928	Rudder Pedal	1
3	5118929	Rudder Pedal	2
4	2118306	Pulley	1
	AN26-28	Bolt	1
	AN320-6	Nut	1
5	4118316	Bracket	1
	AN3-6A	Bolt	4
	AF365-1032	Nut	4
6	2074410-4-8-3412	Cable Assembly	Ref
	AN25-18	Bolt	2
	AN320-5	Nut	2
	AN165-465	Turnbuckle Eye	1
	AN155-465	Turnbuckle Barrel	1
7	5116727-1	Tube	1
8	4116769	Rudder Pedal Horn	1
9	1114003-4-11	Bolt (Stop)	1
	AF335-4	Nut	1

KEY TO 351—Continued

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
10	2074410-4-8-5024	Right Rudder Cable Assembly	Ref
	AN25-18	Bolt	1
	AN320-5	Nut	1
11	4116770	Right Rudder Pedal Horn	1
12	1114003-4-11	Bolt (Stop)	1
	AF335-4	Nut	1
13	2074410-7-8-5712	Left Rudder Cable Assembly	1
	AN25-18	Bolt	1
	AN320-5	Nut	1
	1116477	Bumper	1
14	AN3-11A	Bolt	1
	AF365-1032	Nut	1
15	5118931	Rudder Pedal	1
16	5116728-1	Tube	1
17	AN6-34	Bolt	2
	AN310-6	Nut	2
18	2118304	Support Bracket	2
	131079	Bushing	4
	AN3-10A	Bolt	4
	AN3-12A	Bolt	4
	AF365-1032	Nut	8
19	5118930	Rest Assembly	2
	AN3-21	Bolt	4
	AN310-3	Nut	4

4. If tab movement is incorrect, the difficulty can be traced to improper cable lengths. Travel of the cables is limited to the proper distance at the factory by means of stop lugs which are soldered to the cables. The lugs, which are located at the first bulkhead aft of the servo unit, strike against fixed fair-leads attached to the fuselage structure.

5. Secure all turnbuckles with steel safety wire.

(c) RUDDER PEDAL MECHANISM.

1. REMOVAL.

a. Gain access to the rudder pedals by raising the upper hinged fairing on the fuselage nose.

b. Remove the two structural stiffeners located between stations 29-½ and 40.

c. Remove the four rods which connect the rudder pedals to the brake torque tubes.

d. Detach the Adel blocks which support the two sets of three lines located forward of the rudder pedals. This will allow the lines to be raised slightly when the pedal mechanism is removed.

Note

It will not be necessary to disconnect any lines to remove or install the rudder pedal mechanism.

e. Disconnect the rudder bus cables and the rudder control cables at the horns. (See figure 351.) Access to the horns is gained by removing the door on the under side of the fuselage.

f. Remove the bolts (figure 351) from the two rudder pedal brackets, and screw out the bushings. This will free both the left and right pedal assemblies.

g. Remove the pedals from the arms on the pilot's side.

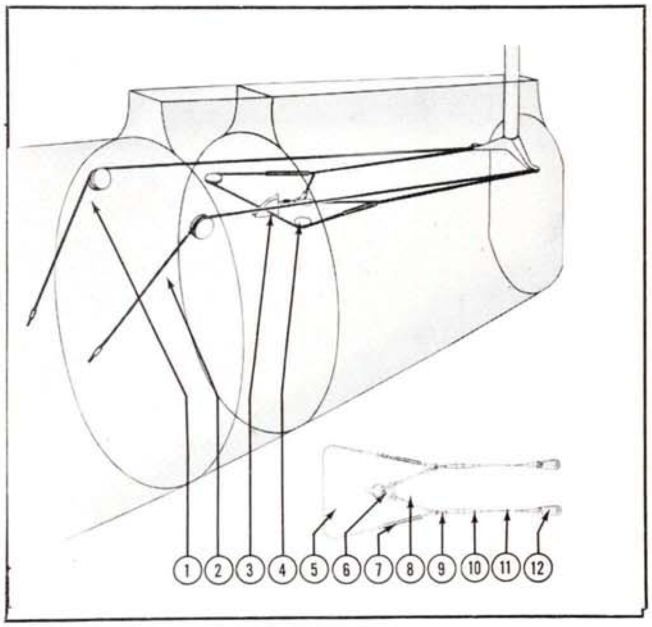


Figure 352—Rudder and Rudder Stop Cables in Aft Section

KEY TO FIGURE 352

(For cable manufacturing information refer to section IX.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2074410-7-8-11208	RH Rudder Cable	1
2	2074410-7-8-11208	LH Rudder Cable	1
3	2115420	Bracket	1
4	3114941	Rudder Stop Cable Assembly (See Insert)	1
5	2074406-6-6-5226	Cable Assembly	1
6	AN115-32	Shackle	1
	AN115-21	Shackle	2
	AN23-11	Bolt	2
	AN320-3	Nut	2
7	87 19 W.&M. GA.	Spring	2
8	2074408-8-9-703	Cable Assembly	2
9	1114937	Link	2
	AN23-12	Bolt	2
	AN320-3	Nut	2
10	AN155-21S	Barrel	2
	AN165-21S	Eye	2
11	2074408-4-16-3802	Cable Assembly	2
12	1114940	Lug	2
	AN23-11	Bolt	2
	AN320-3	Nut	2

KEY TO FIGURE 353

(For cable manufacturing instructions refer to section IX. For rigging details see figure 330.)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2116158	Tab Drum at Pedestal	1
2	AN210-2A	Pulley	4
3	2115350-3	Tab Cable at Pedestal	1
4	AN155-8S	Turnbuckle Barrel	2
5	AN210-2A	Pulley	2
6	AN210-1A	Pulley	2
7	AN210-1A	Pulley	2
8	AN210-2A	Pulley	4
9	AN155-8S	Turnbuckle Barrel	2
10	AN210-1A	Pulley	2
11	2074406-4-4-34616	Tab Cable Aft	1
12	AN210-3A	Pulley	2
13	271044	Tab Drum	1

h. Loosen the aft ends of the two braces which extend from the brake valve at station 29-½ to station 40. This will allow clearance for the removal of the pedal mechanism.

i. Remove the right pedal assembly by working it out through the right side of the pilots' compartment.

j. Remove the left pedal assembly in the same way.

2. MAINTENANCE REPAIR OR REPLACEMENT.—A damaged rudder pedal or rudder pedal assembly shall be replaced.

3. ADJUSTMENT.

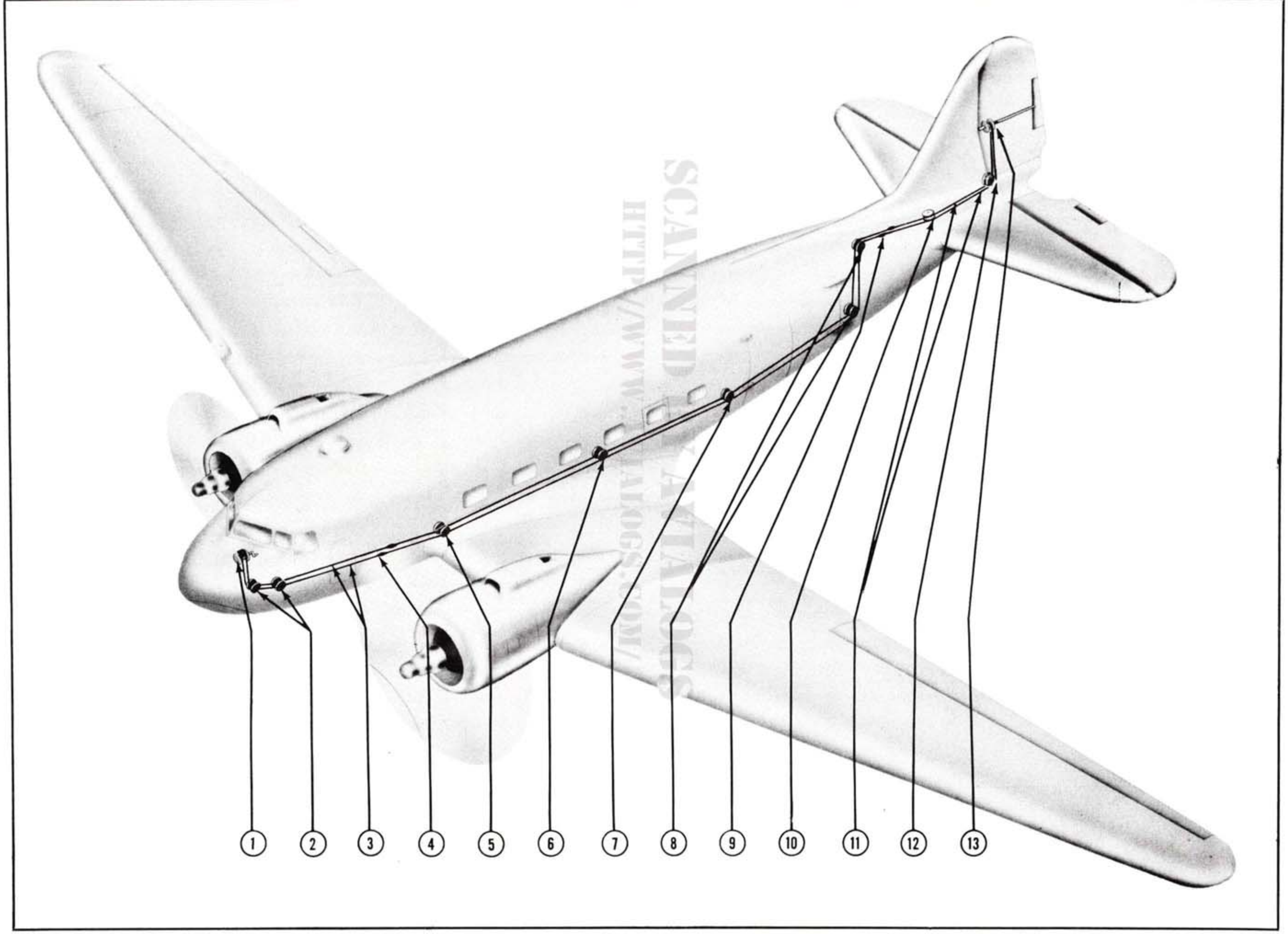
a. Provision is made for adjustment of the rudder pedals forward and aft to accommodate pilots of varying stature.

b. Two rudder pedal stops (figure 351) are installed to adjust the rudder throw.

c. Refer to paragraph 12.*c.*(5)*(b)*, this section, for instructions on adjustment of the rudder pedals when rigging the rudder cables.

(7) WING FLAP CONTROLS. *(See figure 424.)*

(a) DESCRIPTION.—Wing flap movement is controlled by a hydraulic valve located on the hydraulic control panel in the pilots' compartment. During flight, the control handle is maintained in the neutral, or halfway, position. The flaps are lowered by placing the handle in the "DOWN" position and are raised by



①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
⑫
⑬

Figure 353—Rudder Tab Controls

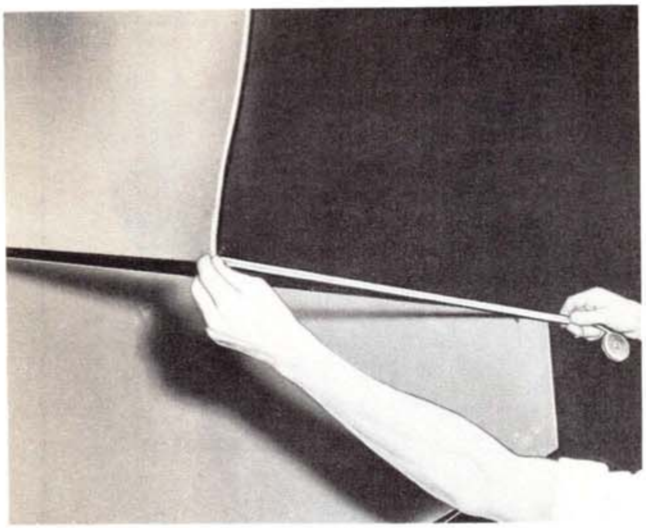


Figure 354—Rudder Throw Measurement

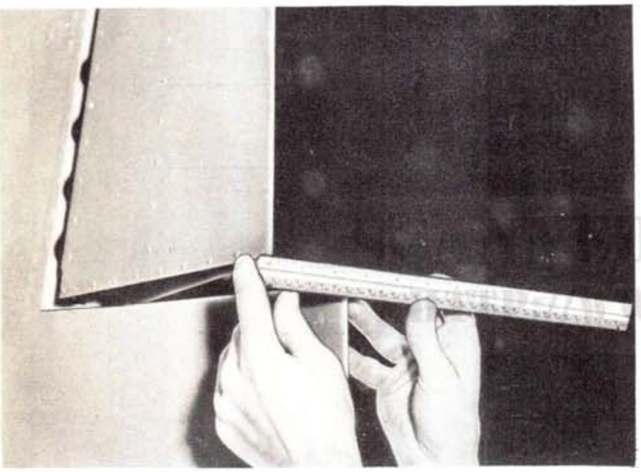


Figure 355—Rudder Tab Throw Measurement

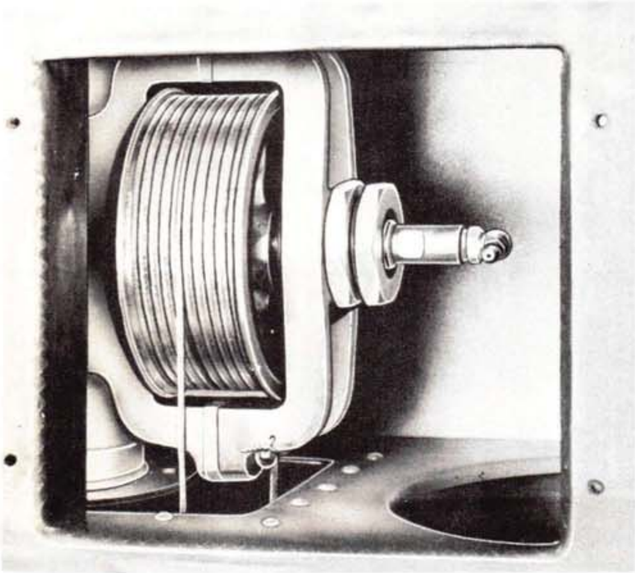


Figure 356—Rudder Tab Drum Installed

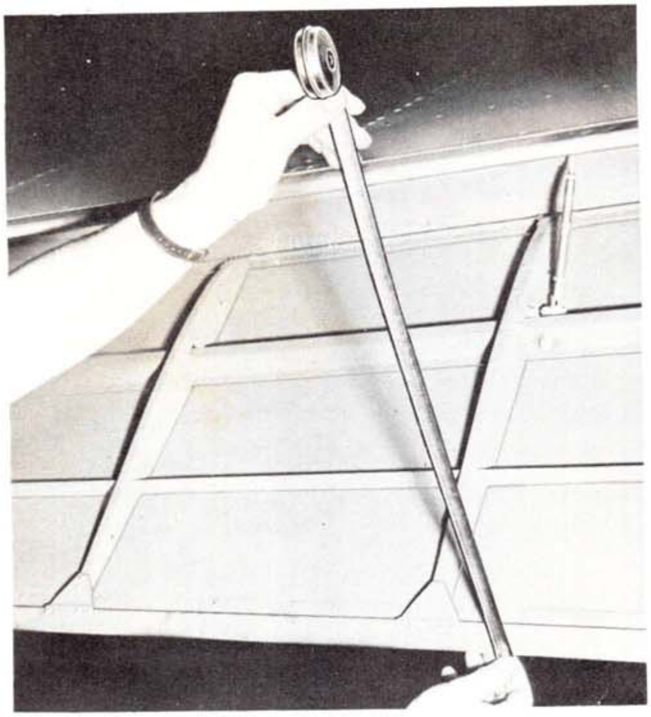


Figure 357—Wing Flap Throw Measurement

placing the control in the "UP" position. When the airplane is on the ground, the control handle must be maintained in the "UP" position at all times. In this position hydraulic pressure is automatically relieved when thermal expansion of the hydraulic fluid occurs. To operate the flaps when the engines are not running, it is necessary to work the hand pump located on the hydraulic control panel. Tubing extends from the hydraulic control valve to the actuating cylinder. (See figure 424.) Both the cylinder and the piston move when hydraulic pressure is applied, actuating toggle rods which are connected to them in the form of a variable parallelogram. The toggle rods are connected to push-pull rods which extend into the wings on rollers and connect with turnbuckles attached to the wing flaps. The extension of the cylinder and piston causes the push-pull rods to move inward and lower the flaps. Contraction of the cylinder and piston causes the wing flaps to rise. The position of the wing flaps is shown on an indicator located on the instrument panel in the pilots' compartment. A wire (figure 424), installed in a conduit, extends from the indicator to the forward end of the hydraulic cylinder. Any movement of the cylinder is shown by an equivalent horizontal movement of the arrow on the indicator.

(b) ADJUSTMENTS. – The following is a wing-flap rigging procedure which is adaptable to field service conditions:

1. Install the hydraulic wing flap cylinder (figure 427) and check all movable joints, rollers, bearings, and guides for freedom of movement and proper lubrication.

2. Check the alignment, movement, and travel of the hydraulic cylinder by sliding the cylinder forward and aft a few times before connecting the rods.

3. Connect the flap operating rods to the actuating cylinder and take up adjustments to make rods as short as possible.

4. Connect all turnbuckles from rod to flap. Adjust turnbuckles until the trailing edge of the flaps is approximately 18-½ inches (45 degrees ± 2 degrees) from the trailing edge of the wing. (See figure 357.)

5. Adjust the flap operating rod until the angle of the turnbuckles to the rod is approximately 75 degrees. Distance between the nuts at the center wing union should be approximately ⅞ inch. Distance between the tube ends in the outer wing should be approximately 1-½ inches.

6. With the hand pump, slowly pump the flaps into the "UP" position, noting any differences in travel and roller clearances.

7. When the flap rods have been adjusted so that all surfaces have equal travel, and trailing edges are in line, tighten turnbuckles until flaps press lightly on the felt pads when in the "FULL UP" position.

CAUTION

The wing flaps must not be preloaded with the actuating cylinder. When the flaps are pressing lightly against the felt pads, the actuating cylinder must be completely "bottomed."

d. TROUBLE SHOOTING, FLIGHT SURFACES AND CONTROLS.

Trouble	*Possible Cause*	*Remedy*
	ELEVATORS	
INCORRECT THROW.	Stop in empennage loose and out of adjustment.	Reset stop, tighten lock nut, and install safety wire.
	Stop loose on control column horn.	Reset stop and tighten lock nut.
	Broken safety wires on turnbuckle barrels at servo unit or in aft section.	Restore cables to tension recommended in cable rigging chart (figure 336); replace safety wire.
	Elevator torque tube inverted (short end on top).	Reverse torque tube.
CONTROL COLUMN HITS INSTRUMENT PANEL OR STOP BRACKET IN PILOTS' COMPARTMENT.	Loose stop or turnbuckles.	Rerig elevator controls. (Refer to paragraph 12.*c.*(3)*(b)*, this section.)
	ELEVATOR TRIM TABS	
TABS MOVE TOO FAR.	Soldered stop lugs located on cables in fuselage below lavatory bulkhead have come off.	Replace stop lugs and solder after readjusting tab throw.
	Elevator tab cables are too loose.	Restore cable tension at turnbuckles in aft section. (See figure 326.)
TAB FLUTTERS.	Play in tab drum in elevator.	Tighten drum adjustment nut.
	AILERONS	
IMPROPER THROW.	Cables stretched.	Restore cables to proper tension. (See cable rigging chart, figure 336.)
	Master differential horn off neutral.	Restore cables to proper tension.
INCORRECT AILERON "DROOP."	Misadjustment of inboard bell crank actuating rod in outer wing panel.	Shorten or lengthen inboard actuating rod.

Trouble	*Possible Cause*	*Remedy*
AILERONS—Continued		
SERVO UNIT "BOTTOMS."	Servo unit not centered when aileron controls are in neutral.	Restore servo unit to correct neutral position by shortening or lengthening cables at servo unit.
CHAINS BIND IN CONTROL WHEELS.	Aileron cables rigged too tightly.	Loosen cables slightly at the turnbuckles located beneath companionway floor.
AILERON TWISTS.	Outboard bell-crank actuating rod out of adjustment.	Readjust outboard bell-crank actuating rod.
AILERON TRIM TAB		
TRIM TAB FLUTTERS.	Play in tab drum in aileron.	Tighten adjustment nut on tab drum.
TAB MOVES TOO FAR.	Soldered stop lugs located on cable in outer wing panel have come loose.	Replace stop lug and resolder after adjusting tab travel.
RUDDER		
RUDDER MOVES TOO FAR.	Improper adjustment of stops at rudder pedals.	Reset stops. (Refer to paragraph 12.*c.* (5)*(b)*, this section.
	Cables in rudder stop assembly loosened due to broken safety wire on turnbuckle.	Check rudder stop cable turnbuckles for broken safety wire; restore cables to proper tension. (See figure 336.)
RUDDER TRIM TAB		
TAB MOVES TOO FAR.	Soldered stop lugs located on cable at first bulkhead aft of servo unit have come loose.	Replace stop lugs and resolder after adjusting tab travel.
TAB FLUTTERS.	Play in tab drum in rudder.	Tighten adjustment nut on tab drum.
WING FLAPS		
UNEVEN TRAVEL OF FLAPS.	Lock nut at actuating tube union in center or outer wing has loosened, lengthening actuating tube.	Readjust actuating tube and tighten lock nut. (Refer to paragraph 12.*c.*(7) *(b)*, this section.)
FLAPS SLUGGISH OR FAIL TO OPERATE.	Aft bushing on hydraulic cylinder rod is out of line and binding on rod.	Bend bushing into correct position.
	Internal leakage in actuating cylinder.	Install new cylinder. (Refer to paragraph 13.*f.*(3), this section.
FLAP FLUTTERS.	Flaps not flush against trailing edge of wing.	Adjust turnbuckles so flaps will be snug with trailing edge of wing.
FLAPS "DROOP."	Fluid leakage at control valve on hydraulic control panel.	Tighten the plug screw on valve. If not effective install new valve.

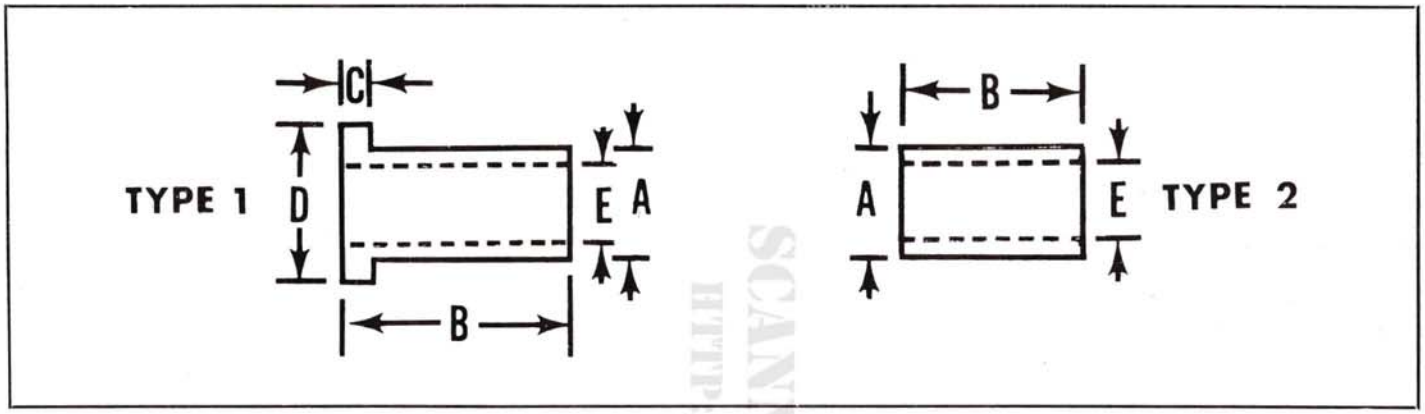


Figure 358—SURFACE CONTROLS BUSHING CHART

Location Key	*Bushing Number*	*Next Assembly*	*No. Req*	*Type No.*	*Dimension "A"*	*Dimension "B"*	*Dimension "C"*	*Dimension "D"*	*Dimension "E"*	*Notes*	*Material*
Outer and Center Wing Flap Eyebolts	1115111	5115204 5115205	14	1	.434 .436	1.1093	.062	.625	Ream .3125 ± .0005	Treat with Permalube	Tobin bronze 1/2 hard Fed. QQ-B-636. Navy 46-B-6
Elevator and Rudder Tab Hinge Brackets	1115097	1115090	6	1	.3125 .3135	.157 .163	.058 .063	.5625	.190 .195	Press fit. Line ream .3125. Used on some airplanes. Later replaced by casting, part No. 1141847	Alum. alloy 24ST Fed. QQ-A-354
Aileron and Rudder Tab Control Shaft	Make from A-839-2 Oilite	1116221	2	2	.878	.875			.750 ± .0005		Oilite bearing
Rudder Pedal Footrest	Make from A-521-1 Oilite	4118922	4	2	.503	.375			.375	Press in and line ream .375 ± .0005	Oilite bearing
Automatic Pilot Shut-off	1026614-3-003	5118747	2	2	.3105	.0937			.1875	Stock dia 3/8	Cold rolled screw steel SAE1120 (Army) 46-S-17GR.A (Navy)
Tab Control Drum Mount	1115091	4115109	3	1	.751 .752	.625	.065	1.125	.6093	Press in and ream to .625 ± .0005	Cold rolled steel
Brake Torque Tube Lock Stop	1139420	5110547	4	2	.385 .388	.187 ± .005			.252 .257	Press fit	7/16 dia bar C.M. steel X4130 ANQQ-S-684 (Army and Navy)
Rudder Pedals	131079	5110547	4	1	.625 + .0000 − .0082	.7185	.0937	.75 Hex	.377 .381	Thread 5/8-18 N.F3 P.D. .5889 + .0000 − .0030	C.R. steel bar screw stock SAE 1120 (Army) 46-S-17GR.A (Navy)
Control Column	131079	5110547	2	1	.625 + .0000 − .0082	.7185	.0937	.75 Hex	.377 .381	Thread 5/8-18 N.F3 P.D. .5889 + .0000 − .0030	C.R. steel bar screw stock SAE 1120 (Army) 46-S-17GR.A (Navy)
Control Column	131079-1	5110547	2	1	.625 + .0000 − .0082	.8437	.0937	.75 Hex	.377 .381	Thread 5/8-18 N.F3 P.D. .5889 + .0000 − .0030	C. R. steel bar screw stock SAE 1120 (Army) 46-S-17GR.A (Navy)
Elevator and Rudder Tab Horn	1115120	1115118	2 ea.	1	.3125 .3135	.255 .260	.115 .120	.5625	.190 .195	Swage in	Bar alum. alloy 24ST or eq. Fed. QQ-A-354 (Army and Navy)

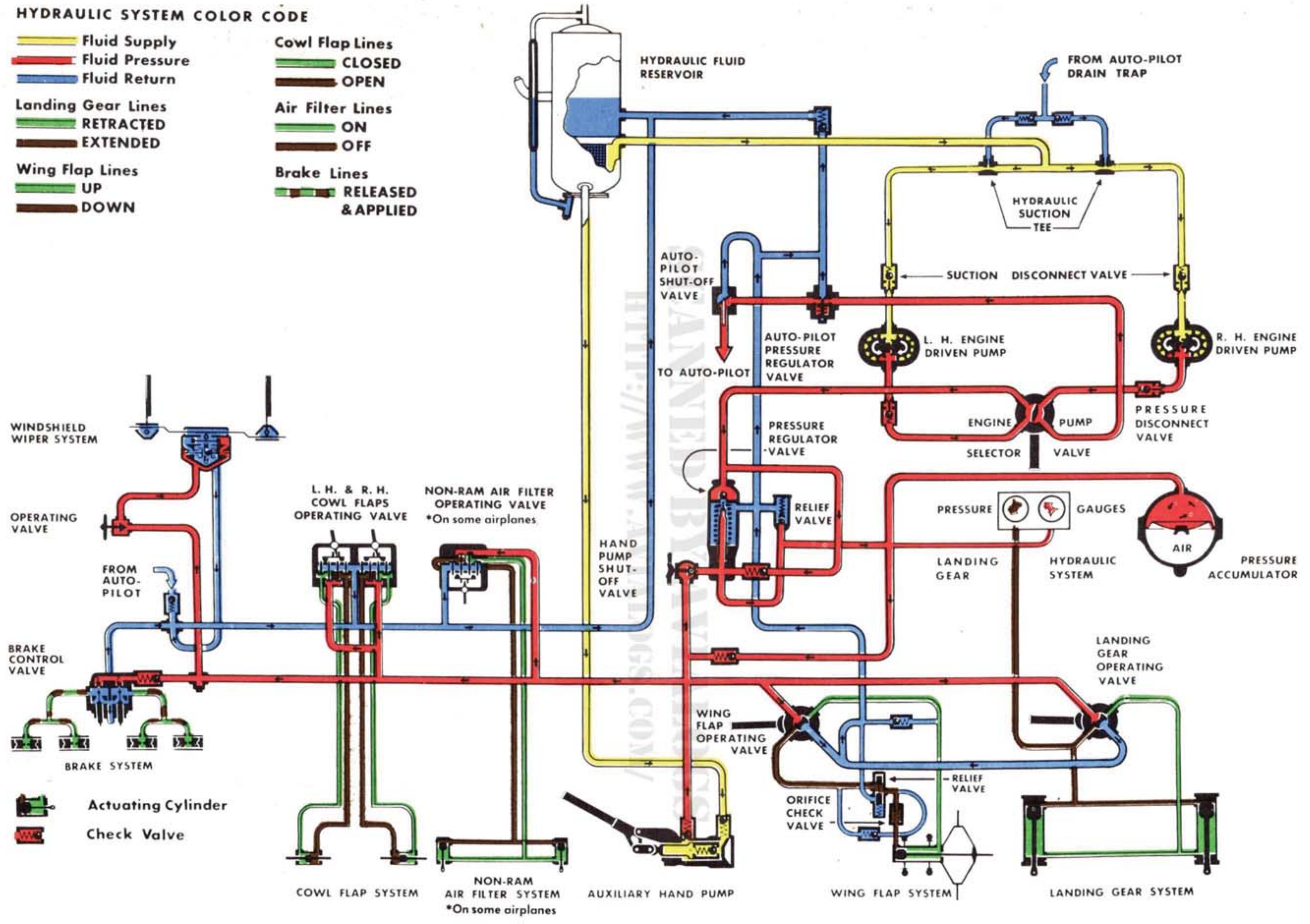

HYDRAULIC SYSTEM COLOR CODE
Fluid Supply
Fluid Pressure
Fluid Return
Landing Gear Lines
RETRACTED
EXTENDED
Wing Flap Lines
UP
DOWN
Cowl Flap Lines
CLOSED
OPEN
Air Filter Lines
ON
OFF
Brake Lines
RELEASED & APPLIED
Actuating Cylinder
Check Valve
HYDRAULIC FLUID RESERVOIR
FROM AUTO-PILOT DRAIN TRAP
HYDRAULIC SUCTION TEE
SUCTION DISCONNECT VALVE
AUTO-PILOT SHUT-OFF VALVE
TO AUTO-PILOT
AUTO-PILOT PRESSURE REGULATOR VALVE
L. H. ENGINE DRIVEN PUMP
R. H. ENGINE DRIVEN PUMP
PRESSURE DISCONNECT VALVE
ENGINE PUMP SELECTOR VALVE
PRESSURE REGULATOR VALVE
RELIEF VALVE
PRESSURE
GAUGES
LANDING GEAR
HYDRAULIC SYSTEM
AIR
PRESSURE ACCUMULATOR
WINDSHIELD WIPER SYSTEM
OPERATING VALVE
FROM AUTO-PILOT
BRAKE CONTROL VALVE
BRAKE SYSTEM
L. H. & R. H. COWL FLAPS OPERATING VALVE
NON-RAM AIR FILTER OPERATING VALVE
*On some airplanes
HAND PUMP SHUT-OFF VALVE
LANDING GEAR OPERATING VALVE
WING FLAP OPERATING VALVE
RELIEF VALVE
ORIFICE CHECK VALVE
COWL FLAP SYSTEM
NON-RAM AIR FILTER SYSTEM
*On some airplanes
AUXILIARY HAND PUMP
WING FLAP SYSTEM
LANDING GEAR SYSTEM

Figure 359—Complete Hydraulic System

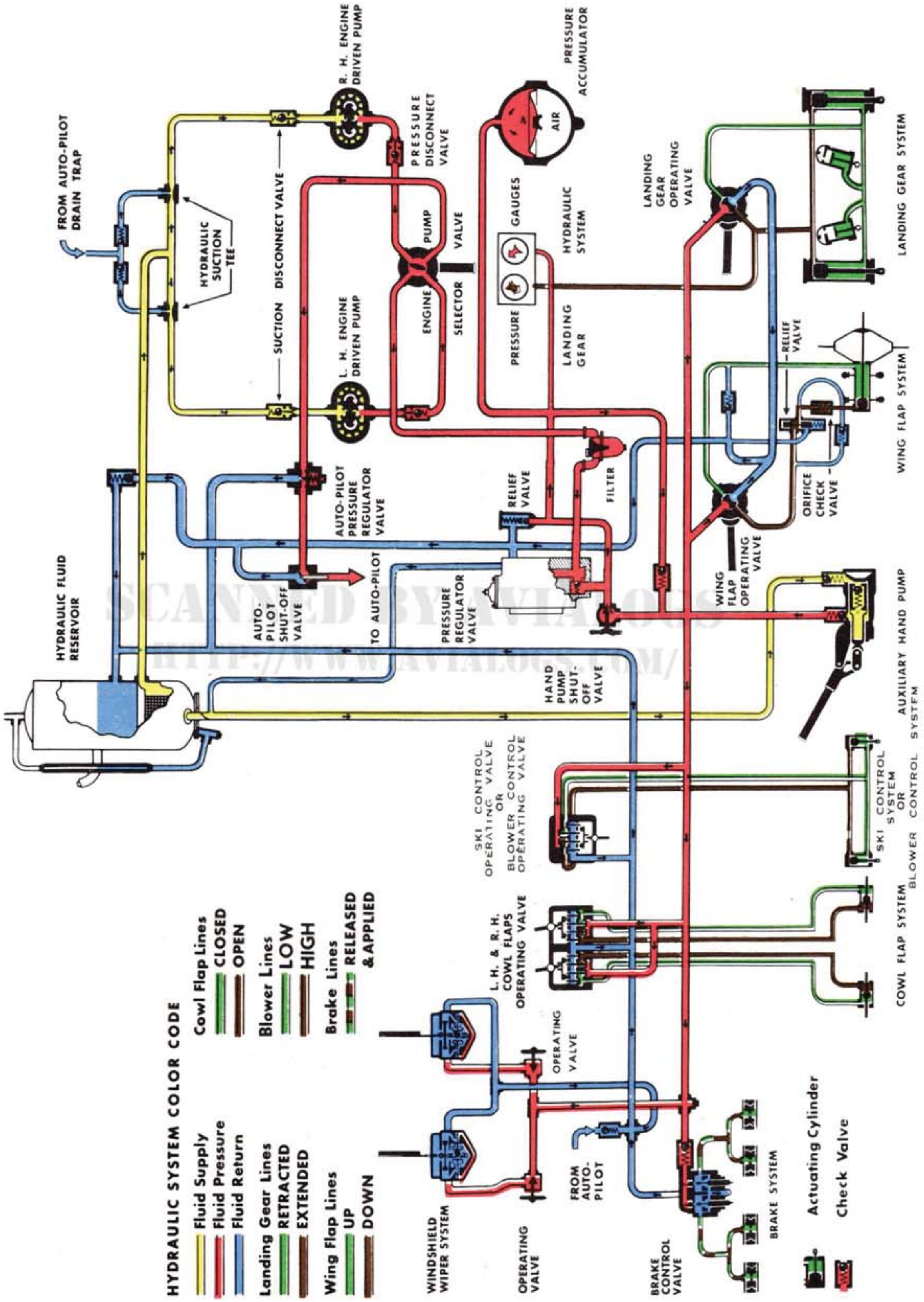

HYDRAULIC SYSTEM COLOR CODE
Fluid Supply
Fluid Pressure
Fluid Return
Landing Gear Lines
RETRACTED
EXTENDED
Wing Flap Lines
UP
DOWN
Cowl Flap Lines
CLOSED
OPEN
Blower Lines
LOW
HIGH
Brake Lines
RELEASED
& APPLIED
Actuating Cylinder
Check Valve
FROM AUTO-PILOT DRAIN TRAP
HYDRAULIC SUCTION TEE
SUCTION DISCONNECT VALVE
R. H. ENGINE DRIVEN PUMP
L. H. ENGINE DRIVEN PUMP
PRESSURE DISCONNECT VALVE
ENGINE PUMP SELECTOR VALVE
PRESSURE ACCUMULATOR
AIR
PRESSURE GAUGES
LANDING GEAR
HYDRAULIC SYSTEM
LANDING GEAR OPERATING VALVE
LANDING GEAR SYSTEM
RELIEF VALVE
WING FLAP SYSTEM
ORIFICE CHECK VALVE
WING FLAP OPERATING VALVE
FILTER
RELIEF VALVE
AUTO-PILOT PRESSURE REGULATOR VALVE
AUTO-PILOT SHUT-OFF VALVE
TO AUTO-PILOT
PRESSURE REGULATOR VALVE
HYDRAULIC FLUID RESERVOIR
HAND PUMP SHUT-OFF VALVE
AUXILIARY HAND PUMP
SKI CONTROL OPERATING VALVE OR BLOWER CONTROL OPERATING VALVE
SKI CONTROL SYSTEM OR BLOWER CONTROL SYSTEM
L. H. & R. H. COWL FLAPS OPERATING VALVE
COWL FLAP SYSTEM
OPERATING VALVE
WINDSHIELD WIPER SYSTEM
OPERATING VALVE
FROM AUTO-PILOT
BRAKE CONTROL VALVE
BRAKE SYSTEM

Figure 359A—Complete Hydraulic System—Late C-47B Airplanes

13. HYDRAULIC SYSTEM.

a. GENERAL.—A pressure-accumulator type hydraulic system (figure 359) is installed in the airplane to operate the landing gear, brakes, cowl flaps, wing flaps, non-ram carburetor air filter mechanism, and windshield wipers. Two engine-driven hydraulic pumps are installed, one on the accessory drive section of each engine, to furnish pressure for the hydraulic system and the automatic pilot. Only mineral oil in accordance **with Specification No. MIL-O-5606 is used in the** hydraulic system and approximately 6 U.S. (5 Imperial) gallons are required to fill the hydraulic system.

Note

> Disassembly of the hydraulic units should be undertaken only when absolutely necessary. If damage to a hydraulic unit is suspected, test it in the airplane before removing it for disassembly. A safe rule is that if a hydraulic unit is operating satisfactorily, LEAVE IT ALONE. For tubing and fittings information refer to section VIII.

b. HYDRAULIC SUPPLY, PRESSURE, AND RETURN SYSTEM. *(See figure 360.)*

(1) GENERAL.—Hydraulic fluid is supplied by gravity from the hydraulic fluid reservoir to the engine-driven hydraulic pumps, which supply fluid pressure for the hydraulic system and the automatic pilot system. During normal operation the left engine-driven pump supplies fluid pressure to the hydraulic system; the right engine-driven pump furnishes fluid pressure to the automatic pilot system. The fluid flow from the engine-driven pumps may be selected by means of the engine pump selector valve, located on the hydraulic control panel (figure 361). The hydraulic fluid under pressure from the engine-driven pumps flows to the engine pump selector valve and the fluid from the engine-driven pump supplying the hydraulic system flows through the hydraulic pressure regulator to the hydraulic pressure accumulator and then to the various systems. The hydraulic-pressure regulator is set to maintain a system operating pressure of 600 to 875 psi. If the hydraulic pressure regulator fails, the system relief valve opens when the system pressure increases to 1000 ± 50 psi and bypasses the excess fluid to the reservoir. The hydraulic hand pump on the hydraulic control panel may be utilized to operate the hydraulic system units when there is insufficient pressure in the hydraulic system or when the engine-driven hydraulic pumps fail. The hand pump also may be used to increase pressure in the hydraulic pressure accumulator for ground operation of the hydraulic system when the engines are not running. The hand pump to pressure accumulator shut-off valve, located on the hydraulic control panel, is installed to provide a bypass around the check valve in the pressure manifold when it is desired to increase pressure in the pressure accumulator by operating the hand pump. In flight, the hand pump shut-off valve must always remain closed and the hydraulic units then are actuated directly by operation of the hand pump. Disconnect valves are installed in the supply and pressure lines at the fire wall so that the engine section may be removed without draining or plugging the hydraulic lines. To fill the hydraulic system observe the following procedure:

(*a*) Use mineral oil, Specification No. MIL-O-5606 (red color).

(*b*) Support the airplane on wing jacks as instructed in section III, paragraph 2.*b.*(1).

(*c*) The landing gear must be extended when filling the reservoir.

(*d*) Charge the hydraulic pressure accumulator, mounted aft of the bulkhead aft of the copilot's seat with air to 250 psi.

(*e*) Remove the plug from the reservoir filler neck which is located on the upper panel of the hydraulic control panel aft of the copilot's seat in the companionway.

(*f*) Pour hydraulic fluid from a clean container into the reservoir filler neck until the fluid level reaches the top arrow of the fluid level sight gage located on the upper hydraulic control panel.

(*g*) Operate the hydraulic hand pump or connect an external test stand at the fire wall disconnect fittings to obtain system operating pressure. Then operate all units of the hydraulic system through their complete range of movement three or four times to expel air from the hydraulic system.

(*h*) Relieve the pressure in the hydraulic system by operating the wing flaps until the hydraulic system pressure gage indicates zero.

(*i*) Remove the airplane from the wing jacks as instructed in section III, paragraph 2.*b.*(1)*(a).*

(*j*) Check the fluid level in the reservoir sight gage and add fluid, if necessary, until the fluid level approaches the top arrow.

(*k*) Start both engines. The hydraulic system pressure gage should indicate 600 to 875 psi when the hydraulic pressure regulator is operating properly. Operate the wing flaps three or four times to bleed air from the hydraulic lines. Check the operation of both engine-driven pumps by moving the engine pump selector valve (figure 361) from the "NORMAL" to the "ALTERNATE" position.

(*l*) Bleed the brakes according to the instructions in paragraph 13.*d.*(2)*(d),* this section.

(*m*) Stop the engines. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates zero. Check; if necessary, add fluid to the hydraulic reservoir to bring the level up to the top arrow on the sight gage.

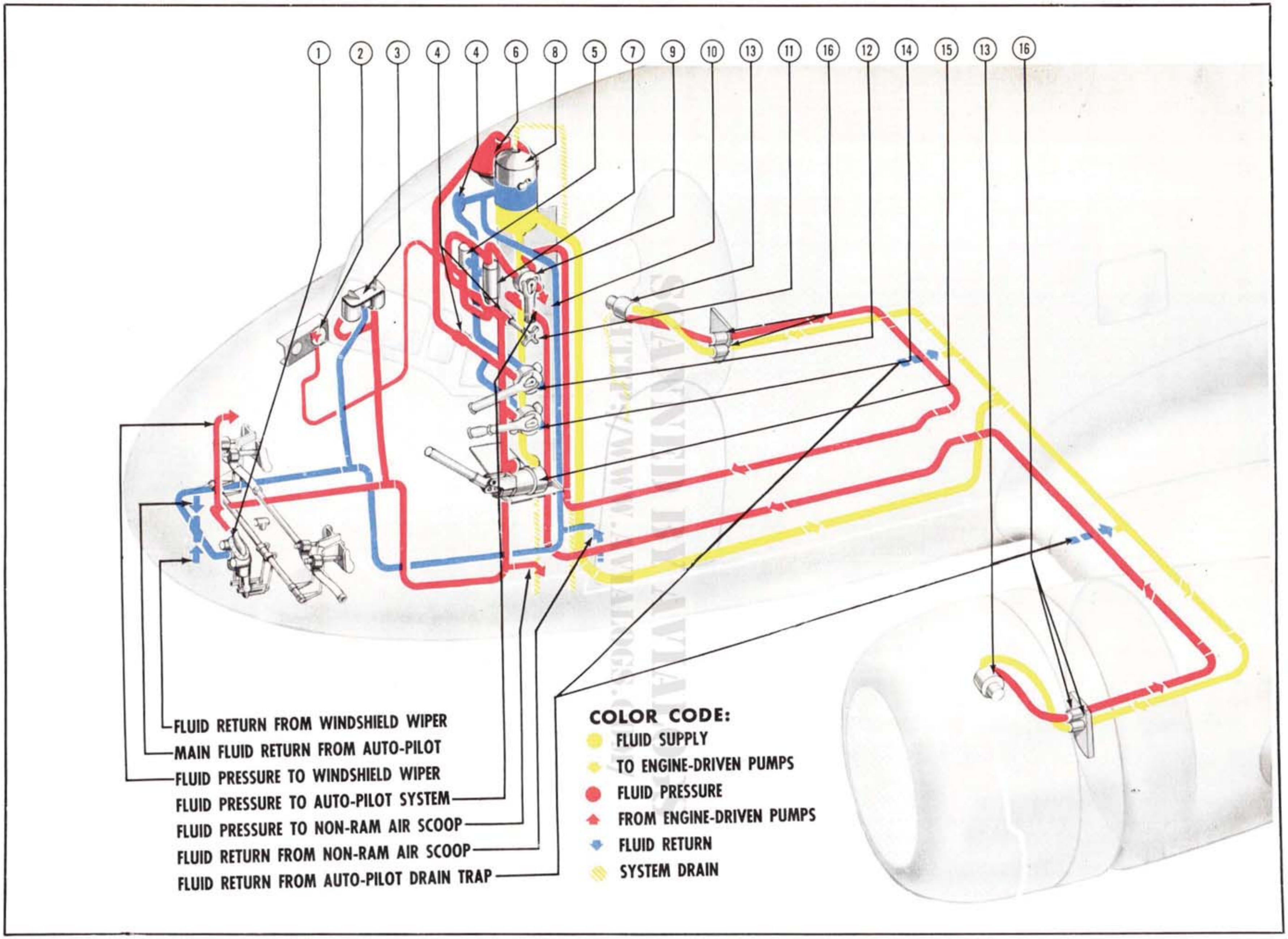

①
②
③
④
④
⑥
⑧
⑤
⑦
⑨
⑩
⑬
⑪
⑯
⑫
⑭
⑮
⑬
⑯
FLUID RETURN FROM WINDSHIELD WIPER
MAIN FLUID RETURN FROM AUTO-PILOT
FLUID PRESSURE TO WINDSHIELD WIPER
FLUID PRESSURE TO AUTO-PILOT SYSTEM
FLUID PRESSURE TO NON-RAM AIR SCOOP
FLUID RETURN FROM NON-RAM AIR SCOOP
FLUID RETURN FROM AUTO-PILOT DRAIN TRAP
COLOR CODE:
● FLUID SUPPLY
◆ TO ENGINE-DRIVEN PUMPS
● FLUID PRESSURE
▲ FROM ENGINE-DRIVEN PUMPS
◆ FLUID RETURN
▨ SYSTEM DRAIN

Figure 360—Supply, Pressure, and Return Hydraulic System

HTTPS://WWW.AVIALOGS.COM/

KEY TO FIGURE 360

(Douglas Dwg. Nos.—5110513, 5141942, 5110553, 5141943, 5110578, and 5204439)

1. Brake Control Valve (See figure 407)
2. Hydraulic System Pressure Gage (See figure 386)
3. Cowl Flap Control Valve Assembly (See figure 423)
4. Check Valves (See figure 385)
5. Hydraulic System Pressure Relief Valve (See figure 375)
6. Hydraulic System Pressure Accumulator (See figure 367)
7. Hydraulic System Pressure Regulator (See figure 368)
8. Hydraulic System Fluid Reservoir (See figure 374)
9. Engine-Driven Hydraulic Pump Selector Valve (See figure 366)
10. Hydraulic Control Panel (See figure 361)
11. Hand Pump to Pressure Accumulator Shut-off Valve (See figure 383)
12. Wing Flap Control Valve (See figure 390)
13. Engine-Driven Hydraulic Pump (See figure 365)
14. Landing-Gear Control Valve (See figure 390)
15. Hydraulic Hand Pump (See figure 376)
16. Disconnect Valves on Fire Wall (See figure 384)

Note

For tubing and fittings information refer to figures 634 and 635, section VIII.

CAUTION

> Do not allow the hydraulic fluid level to go below the level of the bottom arrow on the reservoir sight gage when bleeding the hydraulic system.

(n) Every precaution must be observed in the handling of hydraulic fluid to prevent contamination. The storage containers must be kept sealed; all handling equipment must be kept clean and should be used for hydraulic fluid only. Leakage, poor functioning of hydraulic units, and excessive wear of parts are often caused by contaminated fluid. Do not mix different types of hydraulic fluid because the resulting mixture may cause the packing to seize, deteriorate, and clog the actuating cylinders so that they will fail to operate. Do not expose hydraulic fluid to the air any more than is absolutely necessary. The fluid will absorb dust and grit from the air and this becomes a serious menace. Fluid that has been exposed to dust contamination, or which has been used previously, will be condemned and discarded.

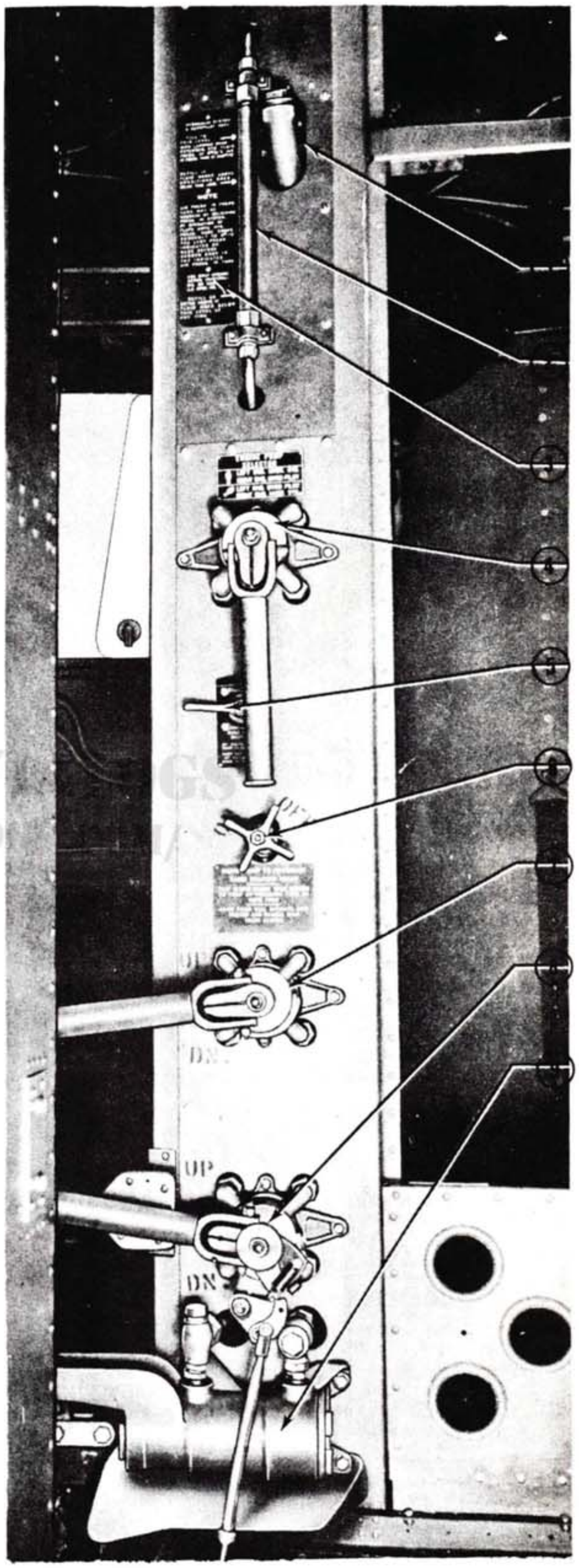


Figure 361—Hydraulic Control Panel (Front View)

KEY TO FIGURE 361

1. Hydraulic Fluid Reservoir Filler Neck
2. Hydraulic Fluid Reservoir Fluid Level Sight Gage
3. Hydraulic Fluid Reservoir Filling Instructions
4. Engine Pump Selector Valve
5. Automatic Pilot Emergency Shut-Off Valve
6. Hand Pump to Pressure Accumulator Shut-Off Valve
7. Wing Flap Control Valve
8. Landing-Gear Control Valve
9. Hydraulic Hand Pump

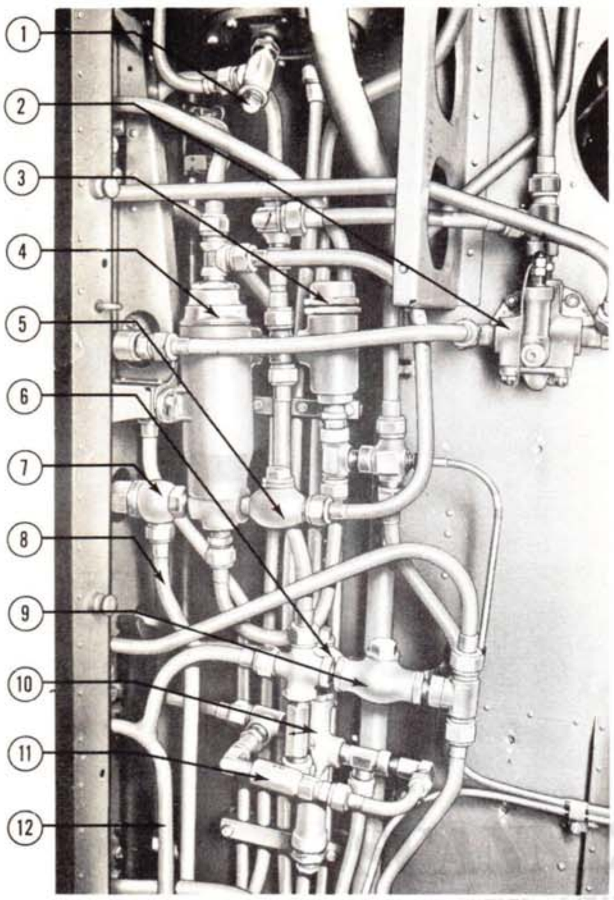


Figure 362—Hydraulic Control Panel (Rear View)

1. Hydraulic Fluid Reservoir Drain Plug
2. Automatic Pilot Pressure Regulator
3. Hydraulic System Pressure Relief Valve
4. Hydraulic System Pressure Regulator
5. Check Valve
6. Check Valve
7. Hand Pump to Pressure Accumulator Shut-Off Valve
8. Pressure Manifold
9. Check Valve
10. Wing Flap Relief Valve Assembly
11. Check Valve
12. Return Manifold

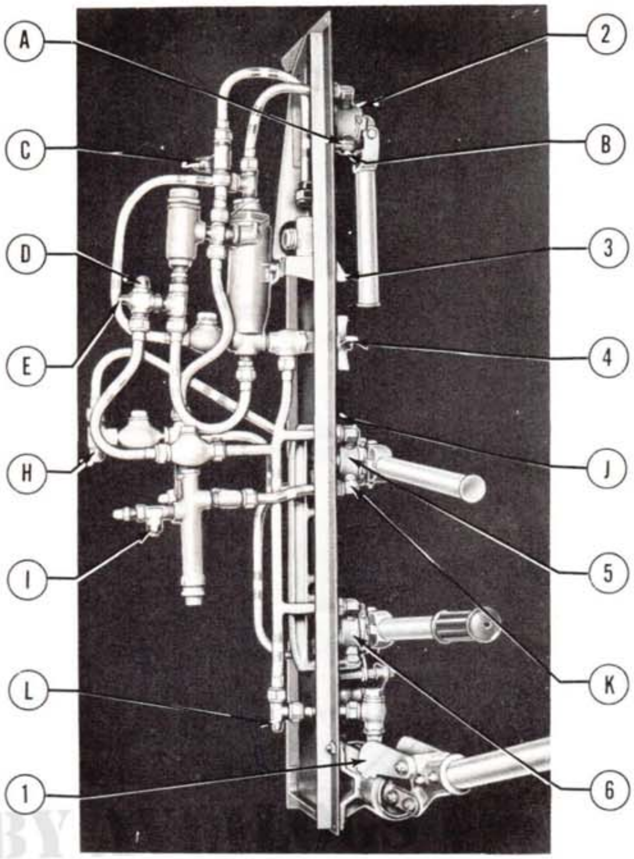


Figure 363—Hydraulic Control Panel Test Connections

(Douglas Drawing No. 5118294)

1. Hydraulic Hand Pump
2. Engine-Driven Pump Selector Valve
3. Automatic Pilot Emergency Shut-Off Valve
4. Hand Pump to Pressure Accumulator Shut-Off Valve
5. Wing Flap Control Valve
6. Landing-Gear Control Valve

NOTE: A, B, C, D, E, H, I, J, K, and L are test connections indicated in fluid leak test procedure.

TEST PROCEDURE

NOTE: Attach 500 ± 25 psi relief valve at port "C" before making the following tests.

Test Port	*Ports Plugged*	*Engine Pump Selector Valve*	*Hand Pump Shut-off Valve*	*Auto. Pilot Shut-off*	*Wing Flap Cont Valve*	*Ldg-Gear Con Valve*	*Test Press.*	*Leakage*	*Flow*
A	D,E,H, I,J,K, and L.	LH Engine to Hyd Syst	CLOSED	ON	DOWN	NEUTRAL	1150 psi	NONE	
A	D,E,H, I,J,K, and L.	LH Engine to Hyd Syst	CLOSED	ON	UP	NEUTRAL	1150 psi	NONE	
A	NONE	LH Engine to Hyd Syst	CLOSED	ON	UP	UP	80 psi		Flow out of ports H and J
A	NONE	LH Engine to Hyd Syst	CLOSED	ON	DOWN	DOWN	80 psi		Flow out of ports I and K

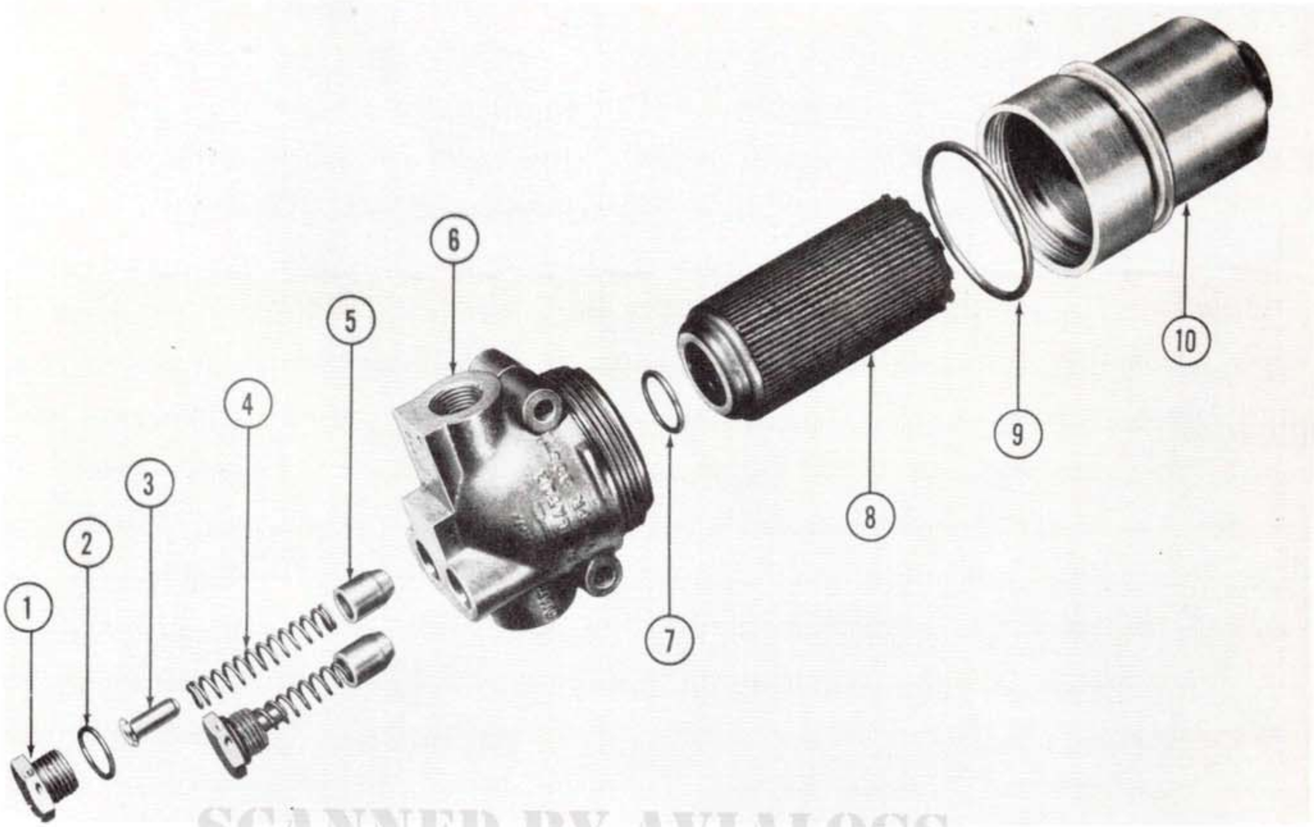


Figure 363A—Purolator Hydraulic Filter (Late C-47A and all C-47B Airplanes.)

1. Cover Screw
2. Gasket
3. Spring Guide
4. Spring
5. Piston
6. Head Assembly
7. "O" Ring Gasket
8. Filter Element
9. "O" Ring Gasket
10. Case

(2) HYDRAULIC CONTROL PANEL.
(See figures 361 and 362.)

(a) DESCRIPTION. — The hydraulic control panel is an assembly of hydraulic valves, fittings, and lines installed on the right side of the companionway aft of the copilot's seat. The control panel is divided into two parts. The lower panel assembly consists of the panel, engine-pump selector valve, the wing flap control valve, the landing gear control valve, the hydraulic hand pump, the hydraulic pressure regulator, the system pressure relief valve, the wing flap relief valve, the hand pump to pressure accumulator shut-off valve, automatic pilot shut-off valve, check valves, and the necessary lines and fittings to connect the hydraulic units in the panel assembly. The upper panel includes the hydraulic reservoir fluid level sight gage and filling instructions. The reservoir filler neck extends into the companionway through an opening in the upper panel. The lower hydraulic panel is installed and may be removed as a single unit for inspection and testing of the complete panel assembly or any of the individual hydraulic units.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

b. Disconnect and cap the hydraulic lines at all connections where the lines deviate from the panel assembly.

c. Remove the bolts attaching the panel to the frames; remove the panel assembly.

2. DISASSEMBLY.—Refer to figure 362 if it is necessary to disassemble the panel assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to the individual hydraulic units for repair or replacement instructions.

(d) ADJUSTMENTS.—Refer to the individual hydraulic units for adjustment instructions.

(e) TESTS BEFORE INSTALLATION.—Refer to figure 363 for fluid leak tests of the hydraulic control panel.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the hydraulic control panel refer to figure 362.

2. INSTALLATION.—To install the hydraulic control panel reverse the removal procedure given in paragraph 13.*b.*(2)*(b)*, preceding.

(g) HYDRAULIC FILTER. (LATE C-47A AND ALL C-47B AIRPLANES.)

(See figure 363a.)

1. DESCRIPTION.—The Purolater Hydraulic Filter No. 31128, Type PR 306-2, consists of a head assembly, an element, an "O" ring gasket, and a case. The head assembly is a machined aluminum casting with inlet and outlet connections, two mounting holes, and two relief valves, whch are set to open and by-pass the element at a pressure difference of 50 pounds per square inch. The head has a smooth tubular projection over which the element fits. Each valve consists of five parts: piston, spring, spring guide, gasket, and cover screw. The filter element assembly is made of specially treated cellulose formed in vertical convolutions bonded to an outlet sealing bushing and base sealing star-shaped washer. The case has an internal thread which fits on the under side of the head. A groove at the base of the threads on the head assembly provides location for the "O" ring gasket. A safety wire is used to secure the case to the head.

2. REMOVAL AND DISASSEMBLY.—Remove the safety wire, unscrew and remove the case and slip the element off of the head. In event the tension of the star-washer on the base of the element causes the element to stick in the case, a slight sidewise movement by hand will assist in the withdrawal of the element. Do not twist or rotate the element to remove it.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Whenever possible replace the old element with a new one. When it is not possible, clean exterior of the element convolutions with a solution of 50 percent Benzine and 50 percent lacquer thinner, using a soft brush. Use care not to damage convolutions of the element. Clean the case, the piston, and the spring, taking special care not to allow dirt to enter the valve hole.

Note

Coat all threads with thread-lube before assembling.

4. ASSEMBLY.—Press the element assembly onto the head, screw case onto the head until the case packing is firmly compressed and the shoulder of the case is against the bottom of the head. Do not tighten excessively; hand tight is sufficient.

5. TESTS.—Check for external leaks by applying first 5 pounds per square inch and secondly 1500 pounds per square inch at one of the ports with the other plugged. Replace safety wire.

6. INSTALLATION.—When installing, be sure "IN" and "OUT" connections are located correctly. The "IN" connection goes to the engine selector valve.

(3) ENGINE-DRIVEN HYDRAULIC PUMPS.

(See figures 364 and 365.)

(a) DESCRIPTION.—Two engine-driven, two-gear, positive-displacement hydraulic pumps are employed to furnish fluid pressure for the hydraulic system and the automatic pilot system. The engine-driven pumps are mounted on the inboard side of each engine accessory section. The pump consists essentially of two steel gears mounted in a closely fitted housing and so arranged that one of the gears is driven by the splined-drive coupling which engages the engine accessory drive, and meshes with and drives the idler or driven gear. The pump housing consists of a body and cover containing matched pairs of bronze bushings which support the two gears. The meshing gears are lubricated by the hydraulic fluid flowing through the pump. The pumping action is accomplished by the meshing of the gears and as the gear teeth separate on one side, a suction is created and fluid is drawn in from the inlet port of the pump. The fluid is carried around between the gear teeth to where the teeth again mesh and the fluid is displaced into the discharge port. This pumping action produces a smooth, positive flow of fluid under pressure from the pump. The pump operates continuously as long as the airplane engine is operating. The drive coupling of the engine-driven pump is provided with a safety shear section to protect the airplane engine in the event of pump failure because of excessive load or jamming of the parts. A drain line is connected to one of the ports in the pump mounting flange to carry away the hydraulic fluid that may work past the drive coupling seal.

Note

Several different types of engine-driven pumps have been used on the airplane. The main difference between the pumps is in the bronze bushings. The pumps on some airplanes have cast-in bronze bushings in the pump body and fixed clearances between the bushings and the gears. In other airplanes the pump has loosely fitted seal-type, pressure-loaded bushings which provide automatic compensation for wear and more satisfactory operation in cold weather. The two pumps also differ in the seal arrangement for the drive-shaft coupling. All pumps operate properly in one direction of rotation only. Later pumps incorporate check valves which are not found in the earlier pumps.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

b. Disconnect the flexible hoses leading to the engine-driven pump at the disconnect fittings on the fire wall. Cap the exposed ends of the flexible hose. Disconnect and cap the pump drain line.

c. Remove the nuts that attach the pump to the mounting pad. Remove the pump and flexible hoses from the airplane.

Note

After the hydraulic pumps have been removed, inspect the auxiliary drives as described in paragraph 6.b.(1)*(b)*.

HTTPS://WWW.AVIALOGS.COM/

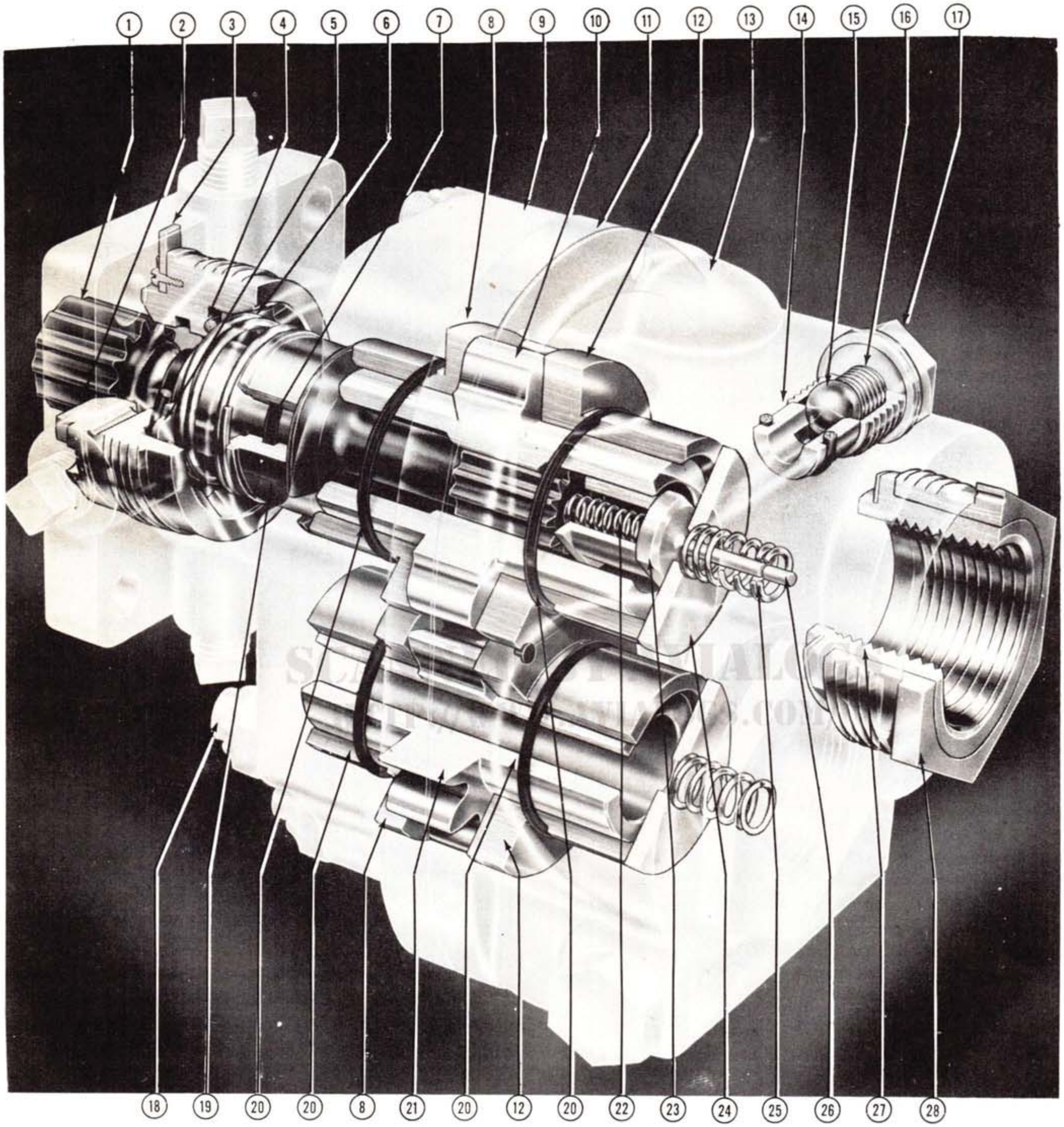

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
20
8
21
20
12
20
22
23
24
25
26
27
28

Figure 364—Engine-Driven Hydraulic Pump Assembly

1. Drive Shaft
2. Retainer
3. Lock Plate and Screw
4. O-Ring Packing
5. Seal Disc
6. Spring
7. O-Ring Packing
8. Body Bushings
9. Pump Body
10. Drive Gear
11. Cover Gasket
12. Cover Bushings
13. Pump Cover
14. Ball Check Seat and Packing
15. Ball Check
16. Spring
17. Retainer and Gasket
18. Cover Stud and Nut
19. Seal Cup
20. O-Ring Packing
21. Driven Gear
22. Drive Shaft Spring
23. Spring Guide
24. Spacer
25. Spacer Spring
26. Pin
27. Port Adapter and Gasket
28. Adapter Nut

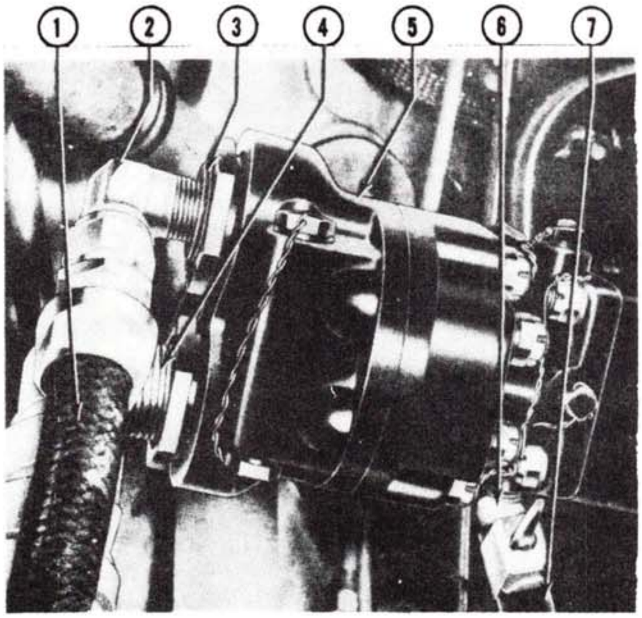


Figure 365—Engine-Driven Hydraulic Pump Installed

1. Pump Pressure Hose Assembly
2. 8CT-S Parker Elbow
3. AN912-8 Bushing Reducer
4. 12CT-S Parker Elbow
5. 2203932 Engine-Driven Hydraulic Pump (Pesco 1P582CA, 1P582CAC, or 1P582K)
   Pesco 214U Used on Earlier Airplanes
6. AF851-4 Hose Elbow
7. Hose Connection for Pump Drain Line

Note

On some airplanes AN912-8 bushing reducers were installed in both ports of the pump and two 3/8 I.P. Street elbows were used instead of the Parker elbows.

2. DISASSEMBLY.—Disassembly of the engine-driven pump should be undertaken only at repair depots where complete facilities for repair and testing are available.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the engine-driven hydraulic pump is damaged, the drive coupling shears, or the pump is not functioning properly, it should be replaced with a new or serviceable pump.

(d) INSTALLATION.

1. If a new engine-driven pump is installed, drain the oil from the pump and flush with hydraulic fluid Specification No. MIL-O-5606.

2. Wipe the engine mounting pad to remove any dirt. Turn the pump drive coupling with the fingers to test for freedom of operation. The coupling tension springs of the bushings cause a close fit on the gears. Therefore, do not reject the pump merely because it appears to be too tight.

3. Prior to installation, coat the drive couplings splines with anti-seize compound, Specification JAN-A-669. Also apply a thin coat of the lubricant to all male pipe threads, taking care to keep the first (leading) thread free of all lubricant.

4. Note carefully the direction of rotation of the engine drive and make sure that the rotation of the pump corresponds. On later pumps make sure that the check valves and plugs are in their proper position as specified on the instruction plates attached to the pump.

5. Place the gasket on the mounting pad. Mount the pump on the studs. Tighten the mounting nuts evenly and tightly and lock with safety wire.

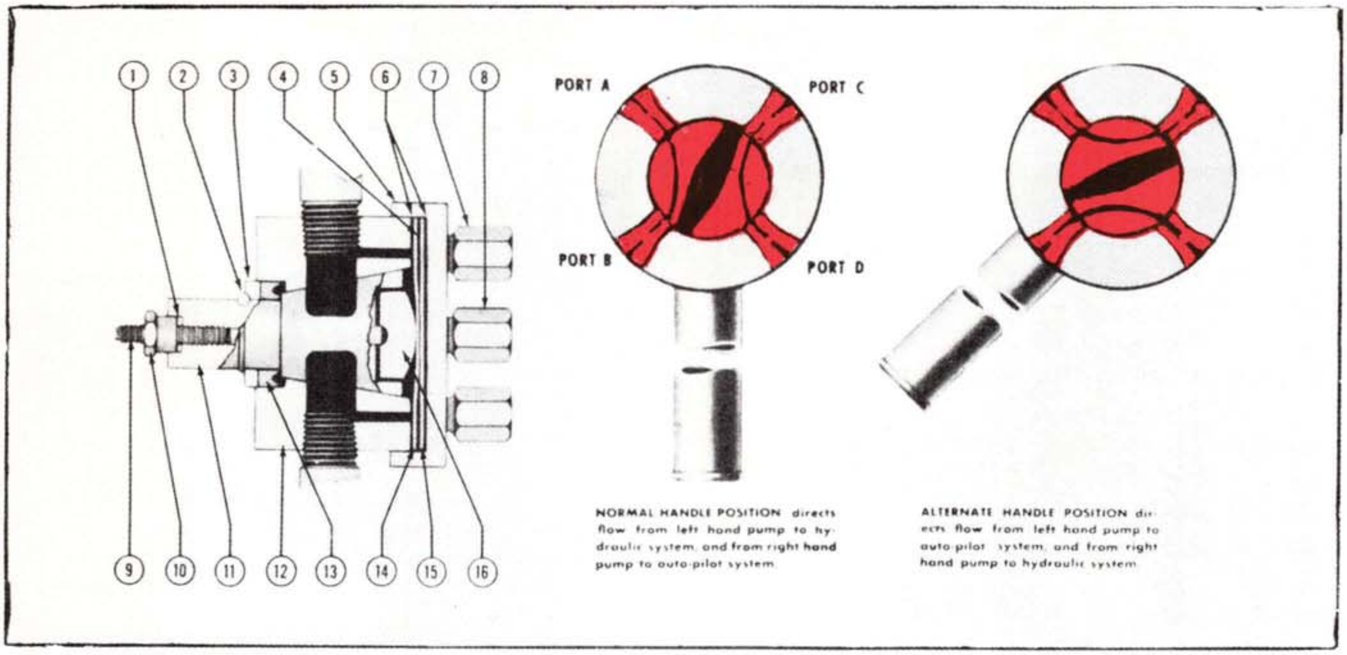
6. Install the elbows in the pump ports. Install the flexible hoses and connect the drain line.

7. Check the fluid supply line from the hydraulic reservoir to the pump for any leaking connections. Connections that allow fluid leakage may be tightened moderately to stop the fluid leakage. If tightening will not prevent fluid leakage, the connector or line must be replaced with a new part.

8. After the installation is complete, bleed the entire hydraulic system by operating the hydraulic hand pump to fill the lines and hydraulic units with hydraulic fluid. Operate all hydraulic units through their complete range two or three times to expell any air. This bleeding must be done thoroughly to eliminate air bubbles and pockets that might cause the hydraulic system to be inoperative.

(4) ENGINE-DRIVEN HYDRAULIC PUMP SELECTOR VALVE.

(a) GENERAL DESCRIPTION.—The engine-driven hydraulic pump selector valve, located on the hydraulic control panel (see figure 361) below the hydraulic reservoir sight gage, controls the flow of fluid from the engine-driven hydraulic pumps. Two makes of valves have been installed; the first, on early C-47A and early C-47B airplanes; second, on late C-47A and late C-47 B airplanes. The two makes of valves are completely interchangeable. The passages in the selector valves are so arranged that the flow of fluid cannot be shut off. The valve is connected to both engine-driven hydraulic pump pressure lines, the hydraulic filter of the hydraulic system, and the automatic pilot system. When the selector valve control handle is in the normal aft position, the left engine-driven hydraulic pump supplies fluid pressure to operate the main hydraulic system, while the right engine-driven pump supplies fluid pressure for operation of the automatic pilot. When the valve control handle is moved to the alternate position, the right engine-driven pump is connected to the main hydraulic system and the left engine-driven pump is connected to the automatic pilot system. The control handle operates in a notched quadrant and it is necessary to lift the handle slightly before moving it from one position to another. There is no difference in the functioning of the hydraulic system when the fluid delivery of the engine-driven pumps is changed. If one engine-driven pump should fail, the hydraulic pump selector valve provides a means of operating either the hydraulic system or the automatic pilot system (but not both) with the fluid pressure supplied by the pump that is still functioning.



NORMAL HANDLE POSITION directs flow from left hand pump to hydraulic system, and from right hand pump to auto-pilot system.

ALTERNATE HANDLE POSITION directs flow from left hand pump to auto-pilot system, and from right hand pump to hydraulic system.

Figure 366—Engine-Driven Hydraulic Pump Selector Valve Assembly—Early Airplanes

1. Washer
2. Lock Ring
3. Washer
4. Gasket
5. Base
6. Gasket
7. Stud
8. Stud
9. Screw
10. Nut
11. Plug
12. Body Assembly
13. Packing Cup
14. Diaphragm
15. Diaphragm
16. Bearing

TEST PROCEDURE

NOTE: Before beginning test adjust handle load to 14 ± 4 pounds at 9-5/8 inches (handle length) with 5 to 7 psi at port A with ports B and C plugged.

Test Port	*Ports Plugged*	*Handle Position*	*Test Pressure*	*Handle Load*	*Max. Leakage*	*Packing Cup*
A	B and C	Normal to Alternate	1000 psi	---	10 drops per hr at D. 5 drops per hr at front of valve	Removed
A	B and C	Normal to Alternate	1000 psi	---	10 drops per hr at D. 1 drop in 48 hrs past cup	Installed
D	A,B, and C	Normal to Alternate	300 psi	20 to 38 lbs	1 drop in 48 hrs past cup	Installed

NOTE: After satisfactory completion of the tests set the handle load to 3 ± 1 pounds at 9-5/8 inches (handle length) with 5 to 7 psi at port "A" with ports "B" and "C" plugged.

(b) HYDRAULIC PUMP SELECTOR VALVE—EARLY AIRPLANES.

(See figure 366.)

1. DESCRIPTION.—This is a tapered plug valve, one of the simplest types of hydraulic control valves. Initial seating force on the plug is obtained by setting the adjusting screw in the serrated end of the plug, and is controlled by increasing or decreasing the tension. The diaphragms and gaskets provide an additional hydraulic seating force against the plug, and the drain hole in the plug allows relief to prevent a hydraulic lock above the plug and to permit proper seating. The valve controls only the direction of the flow of the hydraulic fluid, and is designed not to shut off the flow at any handle position.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

(2) Disconnect and cap the four hydraulic lines leading to the valve elbows.

(3) Remove the bolts that connect the valve to the hydraulic control panel and remove the valve from the airplane.

(4) Remove the handle assembly from the valve before disassembling the valve.

b. DISASSEMBLY.—Refer to figure 366 for disassembly procedure. Disassembly of the valve should not be undertaken in the field.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. External leakage around the plug screw may be remedied by tightening the nut on the plug screw. If the leakage is caused by a defective washer, a new washer should be installed.

b. If the engine pump selector valve is damaged or is not functioning properly, it should be replaced with a new or serviceable part.

4. TEST BEFORE INSTALLATION.—Refer to figure 366 for fluid leak tests.

5. ASSEMBLY AND INSTALLATION.

a. ASSEMBLY.—Refer to figure 366 and observe the following assembly instructions:

(1) If the elbows have been removed from the valve body, tin the male pipe threads with soft solder, Federal Specification No. QQ-S-571, and install in the valve body. Do not screw the elbows into the valve body any more than is necessary or the valve body may be distorted.

(2) Check assembly to see if the holes in the valve body are open to the valve ports. If fittings cover the valve ports, drill a 3/32-inch hole to clear.

(3) Lap the plug into the valve body with fine grinding compound after fittings are in the correct position. Clean the plug and valve body thoroughly to remove all traces of grinding compound. Lubricate the **plug with hydraulic fluid, Specification No. MIL-O-5606, and install in the valve body. The edge of the plug should not extend more than 1/64 inch above the packing recess in the valve body.**

(4) Insert the bearing. The convex side of the bearing should not project more than .010 inch above the valve body.

(5) Assemble the diaphragms and gaskets in the order shown on figure 366. The middle gasket should be installed with the slot between the two 5/16-inch studs.

(6) Assemble base on valve body and install studs, washers, and nuts. Set studs in white lead.

(7) Install the plug screw, washer, and nut. Insert the packing cup and washer and secure in place with the lock ring. The washer should extend into the valve body approximately 1/16 inch.

b. INSTALLATION.—To install the engine pump selector valve reverse the removal procedure outlined in paragraph 13.*b*.(4)*(b)(2)*, preceding.

6. MAJOR OVERHAUL.

a. Remove and disassemble the engine pump selector valve as instructed in paragraph 13.*b*.(4)*(2)*, preceding. Refer to figure 380 for rework tolerances.

b. External leakage may be caused by a defective cup packing around the valve plug; a new packing cup should be installed.

c. Internal leakage may be caused by a worn or scored valve plug. The trouble may be remedied by lapping the plug into the valve body with fine grinding compound. DO NOT exceed the rework tolerances specified in figure 380. If the valve plug or valve body cannot be repaired by lapping, new parts should be installed.

Note

Whenever a new valve plug or valve body is installed, the valve plug should be lapped into the valve body with fine grinding compound. Remove all traces of the grinding compound by washing the parts in clear gasoline after the plug is lapped into the valve body.

d. Worn or damaged diaphragms and gaskets should be replaced with new parts.

e. Inspect all remaining parts for wear and make necessary replacements with new parts.

f. When repair of the valve has been completed, reassemble and test for fluid leaks as specified in Test Procedure under figure 366.

(c) HYDRAULIC PUMP SELECTOR VALVE —LATE AIRPLANES. *(See figure 366A.)*

1. DESCRIPTION.—This valve consists of a body, base, operating mechanism, screws, retainers and AN-6227 "0" rings as required. The cylindrical dural body contains four ports tapped for ⅜-inch pipe fittings, equally spaced and radially disposed; and is recessed in one end for the porting plate and "0" ring, and in the other end for the shaft and snap ring. Two semi-circular reliefs or notches milled in the end face provide relief for the handle locking mechanism in either of the two positions. The base is a dural plate which is attached to the body with six fillister head screws and is sealed against the body with an "0" ring. The operating mechanism consists of a shaft, a rotary porting plate and four shear-seals. The steel shaft has one end serrated for the operating handle, a V-type "0" ring sealing groove, and the other end milled for slipping into a broached hole in the porting plate. The shaft is retained in the body with a steel washer and snap ring. The porting plate is a carburized steel disc having two internal flow channels and four port holes. The face of the porting plate is relieved on four sides to prevent shutting off fluid flow when it is being rotated. The shear seals are corrosion resistant steel seats and are held in intimate contact with the lapped face of the porting plate by four spring washers. The hydraulic pressure forces the shear-seals still tighter against the porting plate. Four "0" rings provide hydraulic seals between the shear-seals and the body. There is a quadrant on the body which permits the operating handle to be locked in either of two positions, 90 degrees apart.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic pressure gage indicates zero.

CAUTION

> Before relieving the hydraulic pressure, be sure that the handle of the landing gear control valve is in the NEUTRAL position ONLY. Be sure that the landing gear safety pins are installed, and the wheels blocked.

(2) Disconnect the four hydraulic lines leading to the elbows of the valve being removed.

(3) Remove the bolts that attach the valve to the hydraulic control panel and remove the valve from the airplane. Cap the four open lines.

b. DISASSEMBLY.

(1) Remove the handle assembly.

(2) Compress and remove the snap ring.

(3) Remove the shaft and its associated "0" ring. The shaft retainer may be removed with the shaft.

Note

> For repairing leaks at the shaft, no further disassembly is needed and removal from the airplane is not necessary. Inspect the shaft groove and body bore for damage and replace damaged parts. Install new, lubricated, "0" ring. Reassemble by reversing disassembly procedure to this point.

(4) Remove the six fillister-head screws and lock washers at back of the base plate.

(5) Remove the base plate while holding the valve so that the shaft end points down. (This prevents dropping the internal parts which might be lost or injured in a fall.)

(6) Remove the large "0" ring.

(7) Remove the porting plate.

(8) Remove the four shear-seals with a hooked wire.

(9) Remove the four spring washers.

3. MAINTENANCE REPAIRS.

a. Examine the sealing surfaces of the body bores which contact the "0" rings. These surfaces must be smooth and free of all nicks and scratches.

b. Examine the V-groove on the shaft. This groove must be free of nicks and scratches. Slight scratches may be removed with fine emery or crocus cloth.

c. Examine the porting plate carefully. The flat surface contacting the shear-seals must be smooth and polished. No scratches are permissible. Minute scratches may be removed by lapping with a fine compound against a flat metal surface.

d. Examine the shear-seals. The surfaces which contact the porting plate must be flat and polished. Slight scratches may be removed by careful lapping with fine compound against a flat metal surface. The bottom of the "0" ring groove must be smooth and free of nicks or scratches. Shear-seals should be replaced when their overall height is decreased by wear to .240 inches or less.

e. Examine the spring washers. Any deformed or broken springs should be replaced.

f. Examine all "0" rings. Never reinstall a used "0" ring. Always replace with a new one.

g. Area of base plate contacting "0" ring must be smooth and free of nicks and scratches. Wear on the area contacting the porting plate must not exceed .015 inches in depth.

4. ASSEMBLY.

a. Lubricate "0" ring.

b. Install shaft, inserting it carefully to prevent damage to "0" ring.

c. Insert shaft retainer.

d. Install snap ring.

e. Insert one spring washer in each of the ½-inch holes of the body.

f. Insert four shear-seals, chamfered ends out, with associated "0" rings.

g. Install porting plate over milled end of shaft with recessed face of porting plate flush with base of body.

h. Install the large "0" ring.

i. Secure plate in position with six screws and lock washers.

5. ADJUSTMENTS.

a. Timing of the hydraulic pump selector valve is accomplished as indicated in figure 366B.

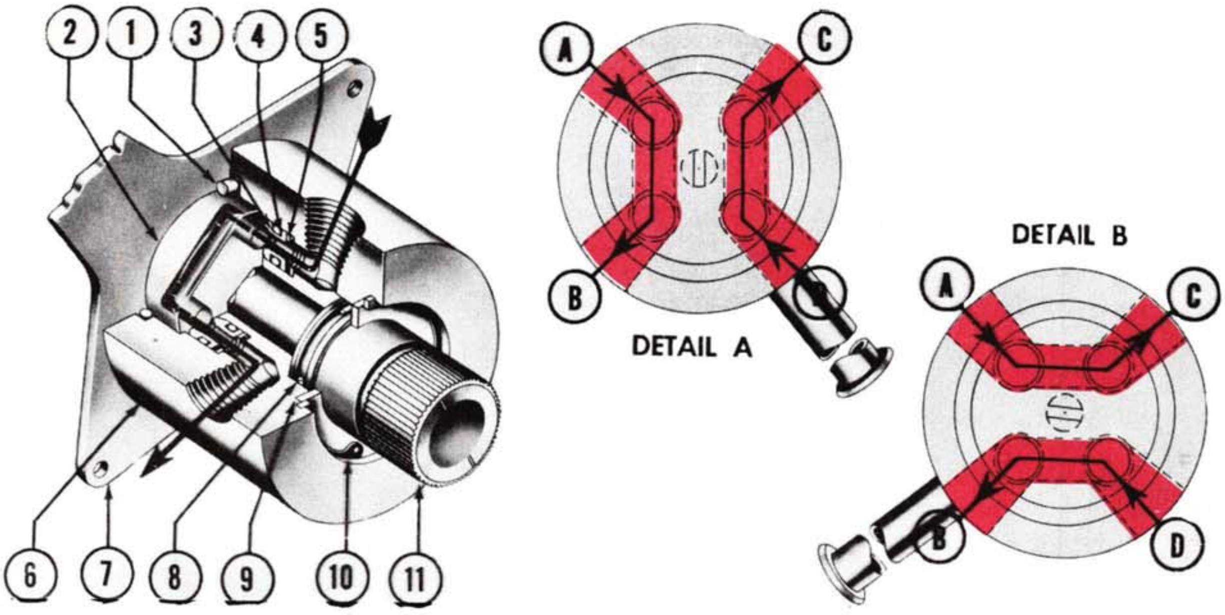


Figure 366A—Engine-Driven Hydraulic Pump Selector Valve Assembly—Late Airplanes

1. "O" Ring
2. Porting Plate
3. "O" Ring
4. Shear Seal
5. Spring
6. Body
7. Base
8. "O" Ring
9. Retainer
10. Snap Ring
11. Shaft

TEST PROCEDURE

To Test	*Apply Pressure At Port*	*Plug Port*	*Shaft Position*	*Test Pressure*	*Remarks*
Port A Shear-Seal	A	B	Neutral	25 psi—4 Min	Check for leakage at port D. Allow 3 minutes for seating. Leakage after this period shall not exceed 1 drop in 3 minutes.
Ports A and B Shear-Seals		C	45 Degrees Counter-Clockwise from Neutral	1500 psi—4 Min	
Port C Shear-Seal	C	A	Neutral	25 psi—4 Min	Check for leakage at port B. Allow 3 minutes for seating. Leakage after this period shall not exceed 1 drop in 3 minutes.
Ports C and D Shear-Seals		D	45 Degrees Counter-Clockwise from Neutral	1500 psi—4 Min	
Shaft and Cover Plate "O" Ring Seals	C	A B D	45 Degrees Clockwise from Neutral	1000 psi—3 Min	Check for external leakage at points 1 and 2. Allowable leakage is 2 drops per 12 hours at shaft. No other external leakage allowed.

NOTES: 1. Pressure drop from Port A to Port B or from Port D to Port C should not exceed 50 psi at a flow of 3 gallons per minute.

2. Pressure applied at Port A (with Ports C and D plugged) or at Port D (with Ports A and B plugged) should not exceed 500 psi to maintain a flow of 3 gallons per minute with shaft in any position between detail A and 70° counter clockwise.

Note

The center line of the handle must coincide exactly with the index mark on the shaft to insure accurate positioning of the porting plate with respect to the shear-seals in order to prevent internal leakage. This is the only way the hydraulic pump selector valve can be timed. See figure 366B.

b. Particular attention should be paid to two facts: first, that the operational travel of this valve is 90 degrees; and second, that the design of the valve incorporates spring loading of the shear-seals in static condition, and hydraulic loading of the shear-seals in operation. Handle-load adjustment is, therefore, dispensed with.

CAUTION

It is urgently important that the handle of this valve be moved its entire travel in operation. Stopping even slightly short of full "NEUTRAL" or full "OPEN" position allows unloading of the valve through the body.

6. TESTS BEFORE INSTALLATION.

a. The valve may be tested for leakage as outlined in tabulation under figure 366A, by applying pressure from a hand or motor operated hydraulic pump.

b. If leakage exceeds allowable leakage given in the tabulation, check for internal leakage due to improper location of handle on shaft, as described in ADJUSTMENTS, this section, paragraph 13.*(c)*5. immediately preceding. If leakage persists, disassemble and carefully inspect "0" rings shear-seals, and porting plates as described in MAINTENANCE REPAIRS, this section, paragraph 13.(4)*(c)*3. preceding.

Note

Use hydraulic fluid per Specification AN-VV-O-366 or equivalent. Bleed out all air from unit prior to test.

7. INSTALLATION.—Attach the hydraulic pump selector valve to the hydraulic control panel, using four bolts, and four lock washers.

(5) HYDRAULIC SYSTEM PRESSURE ACCUMULATOR. *(See figure 367.)*

(a) DESCRIPTION. — The hydraulic system pressure accumulator is a spherical, forged aluminum-alloy container that is divided into two chambers by a synthetic rubber diaphragm. The pressure-accumulator housing consists of two parts held together securely by bolts and studs. The pressure accumulator is attached to a bracket adjacent to the hydraulic fluid reservoir and aft of the bulkhead behind the copilot's seat. (See figure 360.) The lower chamber of the hydraulic pressure accumulator is charged with air through the air valve fitting to an initial pressure of 250 psi with no hydraulic fluid in the upper chamber and no pressure in the hydraulic system; the diaphragm then is fully extended against the wall of the upper chamber. The hydraulic pressure accumulator is connected to the pressure line from the pressure regulator. When the hydraulic system pressure exceeds 250 psi, the hydraulic

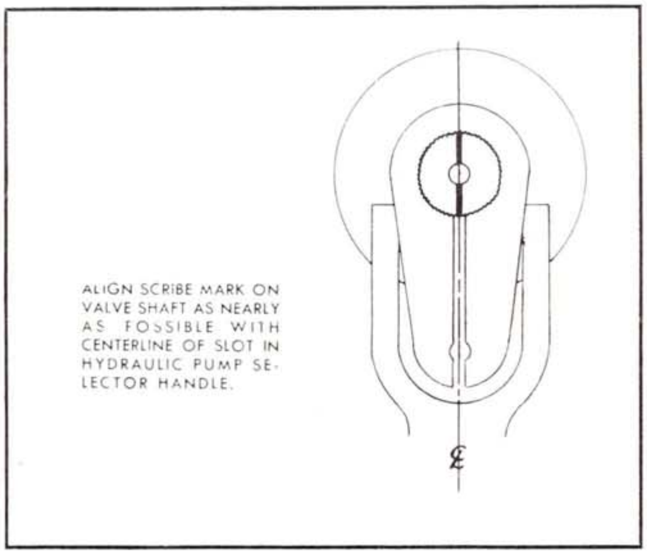

ALIGN SCRIBE MARK ON VALVE SHAFT AS NEARLY AS POSSIBLE WITH CENTERLINE OF SLOT IN HYDRAULIC PUMP SELECTOR HANDLE.
℄

Figure 366B—Timing Hydraulic Pump Selector Valve—Late Airplanes

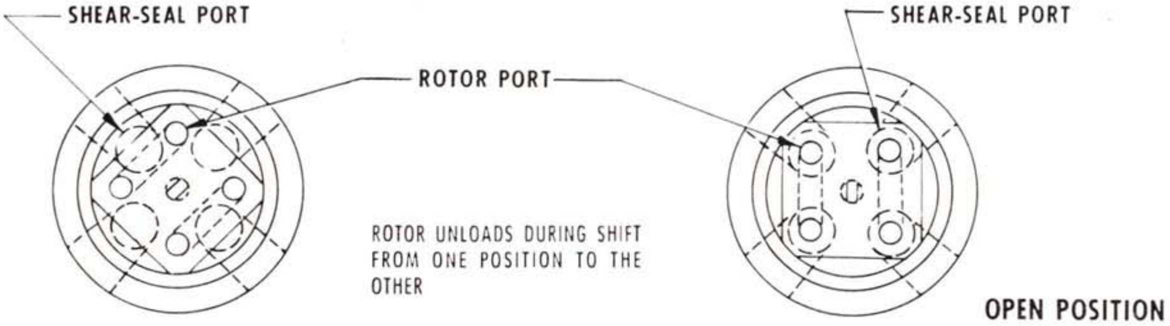


Figure 366C—Hydraulic Pump Selector Valve Rotor—Late Airplanes

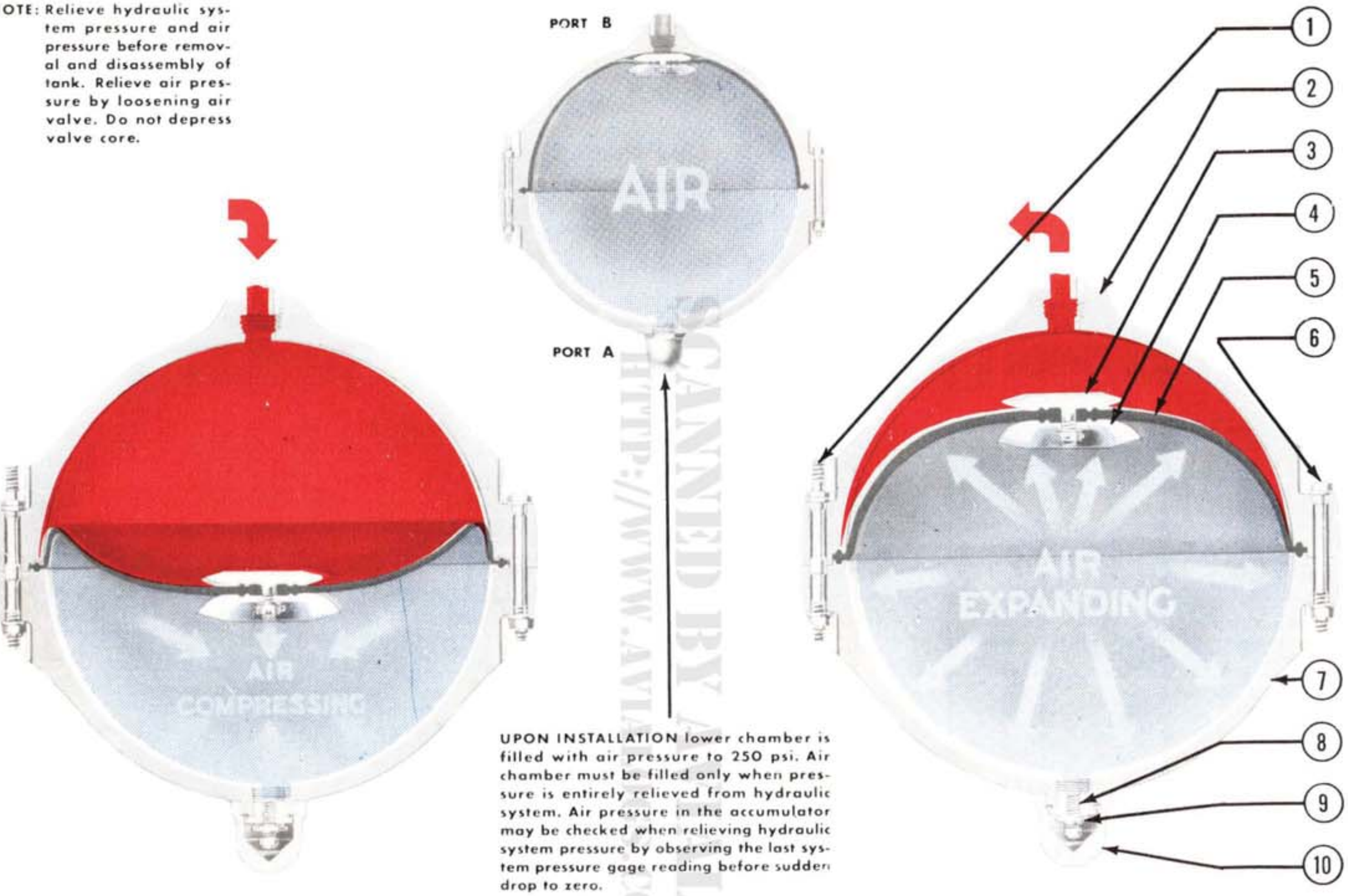
TROUBLE SHOOTING ON THE ENGINE-DRIVEN HYDRAULIC PUMP SELECTOR VALVE LATE AIRPLANES

(Landing gear or wing flaps will not stay in position when valve handle is in neutral.)

Trouble	*Probable Cause*	*Remedy*
EXTERNAL LEAKAGE AT SHAFT	Damaged shaft, AN-6227-13 "O" ring, shaft groove, or body bore	Inspect for damage. Replace shaft or "O" ring AN-6227-13 as noted in this section, paragraph 13. *b.* (4) *(c)* *2* and *4*.
EXTERNAL LEAKAGE AT BASE	Damaged AN-6227-27 "O" ring	See this section, paragraph 13. *b.* (4) *(c)* *2* and *4*, replacing damaged "O" ring.
INTERNAL LEAKAGE	Damaged internal parts or "O" rings	See this section, paragraph 13. *b.* (4) *(c)* *2*, *3* and *4*.
INTERNAL LEAKAGE	Dirt or lintunder seat	Disassemble valve and clean with solvent and lint free cloth.

Note
In any case of apparent internal leakage, first check the valve handle to be sure a full throw of the handle has been accomplished. Improper "timing" of the valve may also be the cause.

NOTE: Relieve hydraulic system pressure and air pressure before removal and disassembly of tank. Relieve air pressure by loosening air valve. Do not depress valve core.



UPON INSTALLATION lower chamber is filled with air pressure to 250 psi. Air chamber must be filled only when pressure is entirely relieved from hydraulic system. Air pressure in the accumulator may be checked when relieving hydraulic system pressure by observing the last system pressure gage reading before sudden drop to zero.

FLUID CHARGING OPERATION

As engine-driven pump increases system pressure above 250 psi, fluid enters upper chamber and forces diaphragm downward compressing air in lower chamber to an equal pressure. At regulated system pressure of 875 psi, hydraulic fluid occupies approximately three-fourths of the volume in the accumulator.

COLOR CODE:

○ AIR

● HYDRAULIC FLUID

EXPELLING FLUID OPERATION

When a control valve employs system pressure to operate an actuating cylinder, system pressure drops relieving pressure of fluid in upper chamber on compressed air in lower chamber. Expanding air instantly forces fluid into the hydraulic system to the cylinder in operation. When cylinder completes operation, accumulator is automatically recharged by the engine pump.

Figure 367—Hydraulic System Pressure Accumulator

KEY TO FIGURE 367
(Douglas Dwg. No. 5133124)
TEST PROCEDURE

Test Sequence	*Test Port*	*Ports Plugged*	*Test Pressure*	*Maximum Leakage*	*Remarks*
1	B	See Remarks	1500 psi oil pressure	None	Back off air valve at A slightly to allow entrapped air to escape
2	A	None	50 ± 30 psi air pressure	——	Diaphragm valve must not seat off center more than .25 inch. The vacuum at "B" must be relieved after relieving pressure at "A"
3	A	None	450 psi air pressure	None	Make this test with accumulator submerged in water
4	B	None	450 psi initial air pressure at "A". Apply 1500 psi oil pressure at "B"	None	Make this test with accumulator submerged in water

Item	*Part No.*	*Part Name*	*No. Req*
1	1183128	Stud Bolt	3
	AC365-524	Nut	3
	AN960-516	Washer	3
2	4133126	Upper Dome	1
3	1046469	Upper Valve	1
	AN320-3	Nut	1
	AN380-2-2	Cotter	1
4	1046470	Lower Valve	1
5	4046365	Diaphragm	1
6	1046452	Bolt	37
	AF365-524	Nut	37
	AN960-516	Washer	74
7	4133125	Lower Dome	1
8	1046451	Bushing	1
	143908-024-C102-032	Washer	1
9	7607A	Schrader Valve Assembly With Either Schrader Valve Cap No. 2525 or Dill No. 637 and With Either Schrader No. 2300 or Dill No. 302D Air Valve Core; or	1
	SK1517A	Dill Valve Assembly With Either Schrader No. 2525 or Dill No. 637 Valve Cap and With Either Dill No. 302D or Schrader No. 2300 Air Valve Core	1
	143908-016-C-024-032	Washer	1
10	1133127	Cap Nut	1

fluid forces the pressure accumulator diaphragm down and fluid flows into the upper chamber of the pressure accumulator. When the hydraulic system pressure is 875 psi, the pressure accumulator contains approximately 5 U.S. (4.7 Imperial) quarts of hydraulic fluid. The pressure accumulator functions to store energy so that a supply of hydraulic fluid under pressure is available instantly either when the engine-driven pumps are inoperative and/or when fluid is drawn from the pressure system faster than the engine-driven pump can replenish the fluid supply. For example, when the main landing gear is extended, the weight of the landing gear and the air load on the landing gear cause it to drop rapidly. Without the pressure accumulator, the fluid delivery from the engine-driven pump would not equal the amount of fluid needed by the landing gear actuating cylinder and a vacuum would be created in the hydraulic system. The pressure accumulator prevents this condition from occurring by an immediate discharge of fluid under pressure into the hydraulic system when the system operating pressure decreases. When the landing gear has been extended, fluid is returned to the pressure accumulator by the engine-driven pump. The valve in the pressure-accumulator diaphragm prevents extrusion of the diaphragm through the hydraulic port. The pressure accumulator also functions as a shock absorber to dampen surges in the hydraulic system.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

b. Relieve the air pressure in the pressure accumulator by backing off the air valve body sufficiently to allow the air pressure to escape. DO NOT DEPRESS THE VALVE CORE to release the air pressure.

c. Disconnect and cap the line leading to the pressure accumulator.

d. Remove the three nuts that attach the pressure accumulator to the supporting bracket and remove the pressure accumulator from the airplane.

2. DISASSEMBLY.—Disassembly of the pressure accumulator should not be undertaken in the field. When disassembly is undertaken, refer to figure 367 and BE CERTAIN that all air pressure is relieved in the accumulator before the unit is disassembled.

a. Remove the bolts; then remove the studs that secure the pressure accumulator housing.

b. Remove the upper half of the housing; then remove the diaphragm.

c. Disassemble the valve in the diaphragm.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—The pressure accumulator requires little maintenance and no lubrication if properly installed. If the pressure accumulator is damaged or is not functioning properly, it should be replaced with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.—Refer to figure 367 for fluid leak tests of the pressure accumulator.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—Refer to figure 367 in conjunction with the following assembly instructions:

a. Remove oil, grease, and dirt from all parts of the pressure accumulator.

b. Check to see that the diaphragm upper valve stud does not extend beyond the bottom of the lower valve.

c. Lubricate the rim groove with hydraulic **fluid, Specification No. MIL-O-5606. Install the diaphragm** and make certain that the diaphragm rim is seated properly in the groove in the pressure accumulator housing.

d. Install the three stud mounting bolts first with the ¼-inch studs at 90-degree intervals on the upper side of the pressure accumulator. Install the remaining bolts, washers, and nuts. Obtain an accurate micrometer reading of each bolt with the nuts loose. Then tighten the nuts evenly around the pressure accumulator until the bolts have elongated .0065 ± .001 inches.

Note

A torque wrench may be used to tighten the nuts if the wrench is calibrated previously by elongating several bolts.

2. INSTALLATION.—To install the pressure accumulator, reverse the removal procedure outlined in paragraph 13.*b.*(5)*(b)*, preceding.

(f) MAJOR OVERHAUL.

1. Remove and disassemble the pressure accumulator as outlined in paragraph 13.*b.* (5)*(b)*, preceding.

2. After disassembly check for presence of hydraulic fluid in the lower half of the pressure-accumulator housing. Evidence of hydraulic fluid indicates leakage of the diaphragm and a new diaphragm must be installed. Check for leakage of the diaphragm around the valve and the sealing rim. Any deterioration, tears, cracks, or holes in the diaphragm will be cause for installing a new part.

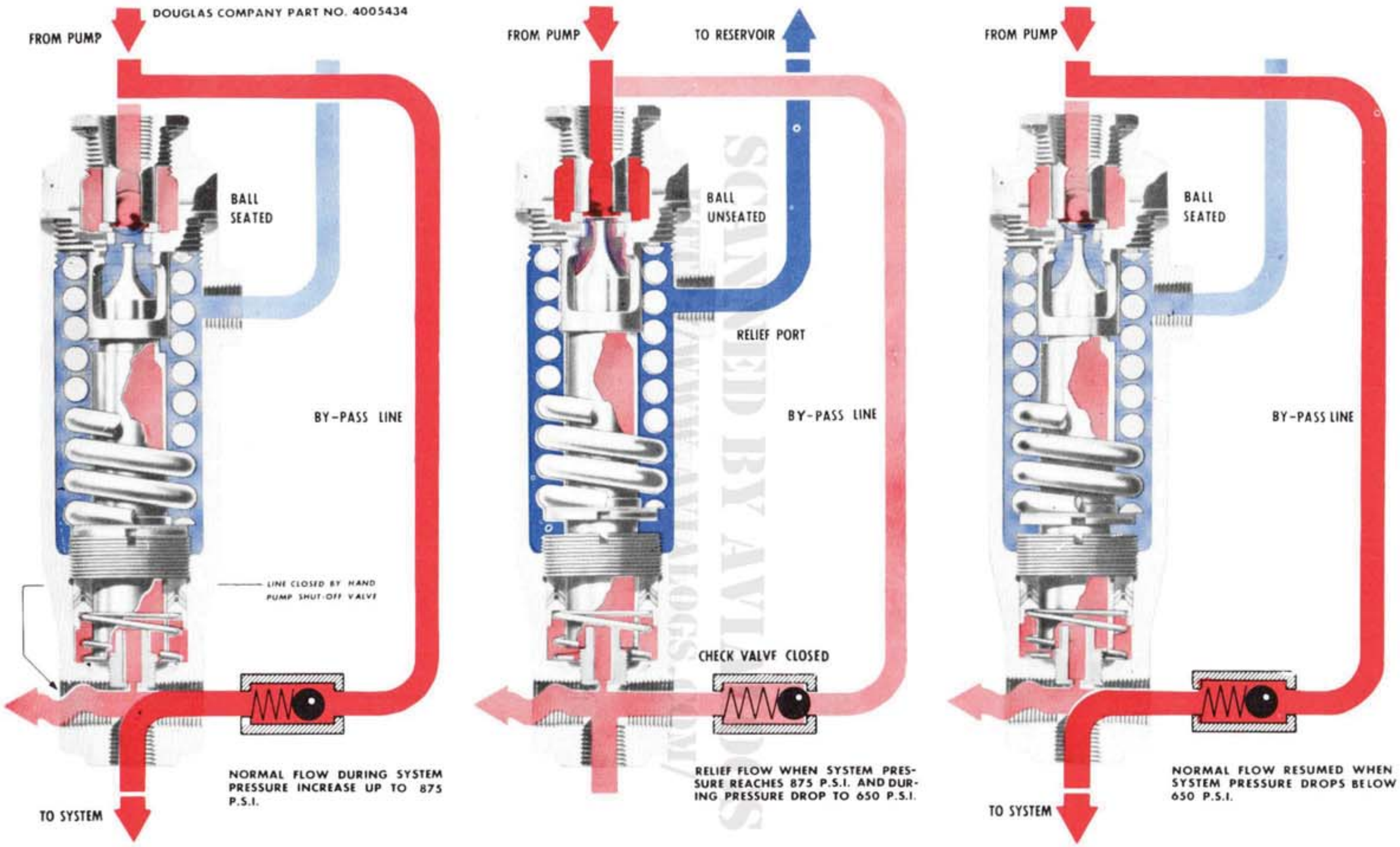
3. Check the pressure-accumulator housing for cracks, deep scratches, and other defects; install new parts if such damage is detected.

4. When repair has been completed reassemble the pressure accumulator and test for fluid leaks as specified in figure 367.

(6) HYDRAULIC SYSTEM PRESSURE REGULATOR.

(a) C-47A AND EARLY C-47B AIRPLANES. *(See figure 368.)*

1. DESCRIPTION.—The hydraulic pressure regulator is installed on the outboard side of the hydraulic control panel and functions to maintain the system operating pressure between 600 and 875 psi. The pressure regulator consists of a cylindrical housing which encloses a spring-loaded piston and ball check. When there is no pressure in the hydraulic system, the piston is held down by the spring and the ball check is seated. Therefore, fluid from the engine-driven pump flows through the bypass line and check valve to the bottom of the regulator and into the system, increasing the system pressure. The increasing system pressure reacts on the inside of the pressure-regulator piston, which is held down by the spring. When the system pressure increases to 875 psi the fluid pressure on the inside of the pressure-regulator piston overcomes the force exerted by the spring and the piston moves up, unseating the ball check. When the ball check is unseated, the fluid then flows into the piston chamber and out of the side port of the pressure regulator into the return line to the reservoir. Since there is no resistance to flow when the ball check is unseated, the load on the engine-driven pump is relieved. The engine-driven pump merely pumps fluid from the reservoir, through the top of the pressure regulator, and back to the reservoir and the engine-driven pump is not working against back pressure. The check valve at the bottom of the pressure regulator prevents any reverse flow from the pressure accumulator and the maximum system operating pressure of 875 psi is maintained. When fluid pressure is utilized to operate any of the hydraulic units, the system pressure decreases. When the system pressure decreases to 600 psi, the spring force overcomes the fluid pressure exerted on the inside of the piston. The piston moves down and the ball check is reseated, closing the passage to the piston chamber and return line to the reservoir. The fluid then flows through the bypass line and check valve increasing the


DOUGLAS COMPANY PART NO. 4005434
FROM PUMP
BALL SEATED
BY-PASS LINE
LINE CLOSED BY HAND PUMP SHUT-OFF VALVE
TO SYSTEM
NORMAL FLOW DURING SYSTEM PRESSURE INCREASE UP TO 875 P.S.I.
FROM PUMP
TO RESERVOIR
BALL UNSEATED
RELIEF PORT
BY-PASS LINE
CHECK VALVE CLOSED
RELIEF FLOW WHEN SYSTEM PRESSURE REACHES 875 P.S.I. AND DURING PRESSURE DROP TO 650 P.S.I.
FROM PUMP
BALL SEATED
BY-PASS LINE
TO SYSTEM
NORMAL FLOW RESUMED WHEN SYSTEM PRESSURE DROPS BELOW 650 P.S.I.

Action: When hydraulic system is not in use to operate an actuating cylinder, increasing system pressure causes a proportional thrust of piston, gradually overcoming spring resistance. System pressure also forces downward on ball valve in upper chamber. This force and that of spring below restrain force within piston tending to unseat the ball.

Flow: Until the hydraulic system pressure reaches 875 P.S.I., the fluid flow from engine-driven pump is directed through the by-pass line around the pressure regulator valve, through the check valve, and through regulator valve's lower port into the hydraulic system. During build-up of system pressure in the pressure accumulator tank, the engine-driven pump operates under an increasing load.

Action: At 875 P.S.I., system pressure forces the piston upwards sufficiently to overcome the combined spring load and proportionate system pressure acting on ball valve in upper chamber. The ball is unseated, removing fluid force acting downward on ball which resisted thrust of piston caused by system pressure. 875 P.S.I. system pressure on base of piston is resisted only by spring tension on piston. When the ball valve opens the by-pass line check valve closes, locking fluid pressure in regulator chamber below piston. Thus sufficient piston thrust is maintained to hold ball valve open until system pressure drops to 650 P.S.I.

Flow: Relief flow begins when ball valve opens, directing pump delivery into spring chamber and through relief port back to reservoir. Relief flow continues until system pressure drops to 650 P.S.I. caused by the operation of an actuating cylinder or leakage. Engine-driven pump has only slight load during period of relief flow.

Action Repeated: When system pressure drops to 650 P.S.I., by leakage or use of hydraulic system to operate an actuating cylinder, the spring load overcomes system pressure forcing piston upward. Spring forces piston down The ball valve closes and system pressure repeats build-up to 875 P.S.I.

Flow Repeated: Normal flow is resumed when system pressure drops to 650 P.S.I. Now fluid enters system through by-pass line until system pressure again reaches 875 P.S.I.

COLOR CODE:

- FLUID PRESSURE
- FLUID PRESSURE FLOW
- FLUID RETURN
- FLUID RETURN FLOW

Figure 368—Operation of Hydraulic System Pressure Regulator (C-47A and Early C-47B Airplanes)

system pressure to 875 psi, thus completing the pressure regulating cycle.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

(2) Caution must be used when removing parts from the hydraulic control panel assembly. Mark all lines and fittings as removed, so they can be replaced in their original positions on the control panel.

(3) Remove the handle from the hydraulic hand pump to pressure accumulator shut-off valve.

(4) Disconnect and cap all lines at the connections indicated on figure 370.

(5) Remove the two nuts and bolts which attach the pressure regulator to the hydraulic control panel. Remove the pressure regulator assembly from the airplane.

b. DISASSEMBLY.—Do not attempt to disassemble the pressure regulator unless adequate tools are available. When disassembly is undertaken refer to figure 369 and observe the following procedure:

(1) Remove the valves and fittings (figure 373) from the pressure regulator.

(2) Remove the safety wire on the top end of the pressure regulator.

WARNING

> Because of the high internal spring loading on the end, the pressure regulator must be held in an arbor press while unscrewing the end. Serious injury to personnel may result if this precaution is not observed.

(3) Bolt the pressure regulator to an arbor press as shown in figure 371. Screw a cap into the fitting in the top of the pressure regulator before using the arbor press.

(4) Remove the top end of the pressure regulator as shown in figure 371. There are several spacing shims installed on top or bottom of the large spring in the pressure regulator. Check the number of spacing shims for future adjustment of the pressure regulator.

(5) Remove the spacing shims, large spring, and piston from the pressure-regulator cylinder.

(6) Remove the packing nut in the pressure regulator cylinder.

Note

> Use service tool No. K21201 as shown in figure 372 to remove the packing nut from the cylinder. If the wrench is not available, a piece of strap iron of the proper width and thickness to fit into the packing nut slots may be used to remove the nut. To fabricate service tool No. K21201, refer to figure 95.

(7) Remove the ring, packing, back-up ring, and small spring from the pressure-regulator cylinder.

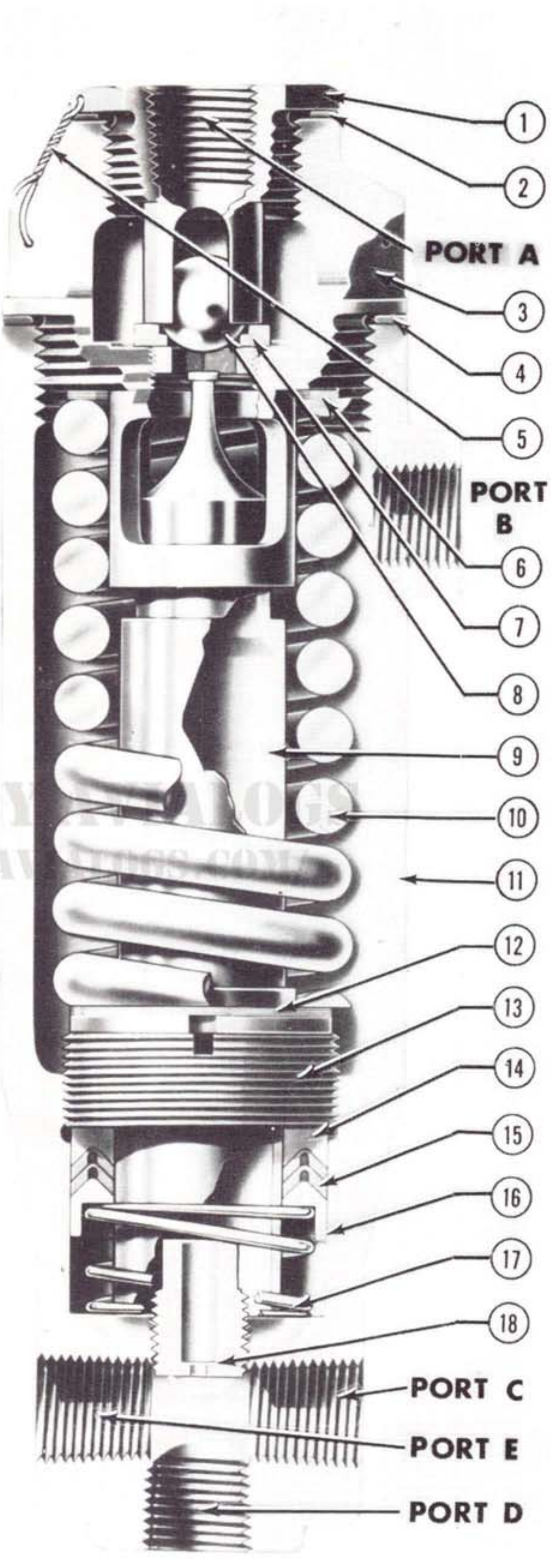


Figure 369—Hydraulic System Pressure Regulator Assembly—Early Airplanes

KEY TO FIGURE 369
(Douglas Dwg. No. 4005434)
TEST PROCEDURE

Test Port	*Ports Plugged*	*Test Pressure*	*Max. Leakage*
A	None	850 psi 1300 psi	1 drop in one hour past ball seat
B	A,C,D,E	125 psi	None—External
D	C and E	1300 psi	1 drop in one hour past packing
D	Plug E Connect A & C	Valve must unseat at 850 to 900 psi and reseat at 600 psi min	———

Item	*Part No.*	*Part Name*	*No. Req*
1	2005429	Bushing	1
2	1161144-18	Gasket	1
3	2005427	End	1
4	1161144-31	Gasket	1
5	AF995-C40-6	Lock Wire	2
6	143908-104R116-010	Shim	As Req
7	1066288	Seat	1
8		9/16 Diameter Bright Steel Ball	1
9	1005410	Piston	1
10	1005430	Spring	1
11	4005433	Housing	1
12	143908-104R116-010	Shim	As Req
13	1072037	Nut	1
14	1070625	Spacer	1
15	AN6225-19 or 5135865-4G-030	Packing	2
16	1072036	Spacer	1
17	1070624	Spring	1
18	PS77030-1	Orifice Snubber	1

(8) To remove the ball check, unscrew the bushing from the top end of the pressure regulator. The seat for the ball is screwed into the top end of the regulator.

3. MAINTENANCE REPAIR OR REPLACEMENT.—If the pressure regulator is damaged or is not functioning properly, it should be replaced with a new or serviceable part.

4. ADJUSTMENTS.—If the pressure regulator does not maintain the proper system operating pressure, 600 to 875 psi, the pressure regulator must be removed and disassembled according to the instructions in this paragraph *b.(6)(b)* and spacing shims (figure 367) removed or added. Removal or addition of one .010 spacing shim reduces or increases the release pressure approximately 15 psi. Reassemble the pressure regulator and test for proper functioning.

5. TESTS BEFORE INSTALLATION.—Refer to figure 367 for fluid leak tests of the pressure regulator.

6. ASSEMBLY AND INSTALLATION.

a. ASSEMBLY.

(1) Make certain all parts are perfectly clean before assembling the pressure regulator.

(2) Install the orifice snubber and stake to regulator as shown in figure 367. The orifice snubber should extend through at least 1½ threads to allow for staking.

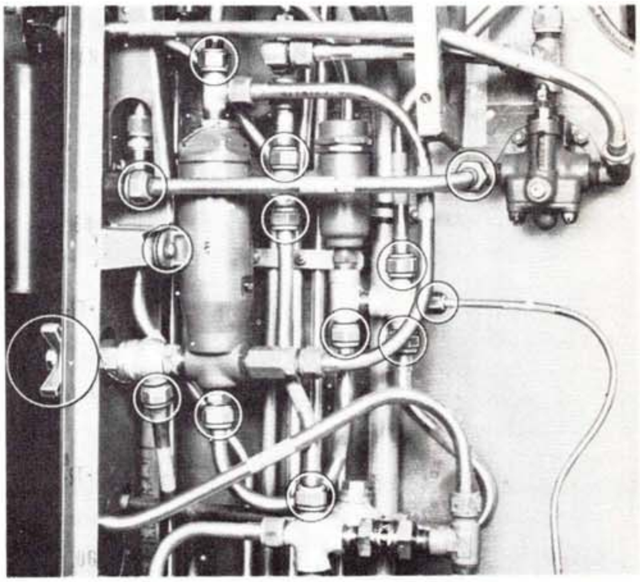


Figure 370—Removal of Hydraulic Pressure Regulator—Early Airplanes

(3) Install the small spring and back-up ring. Check the length of the spring before installation. The correct length is 19/32 inches. Stretch the spring if it is shorter than the correct length.

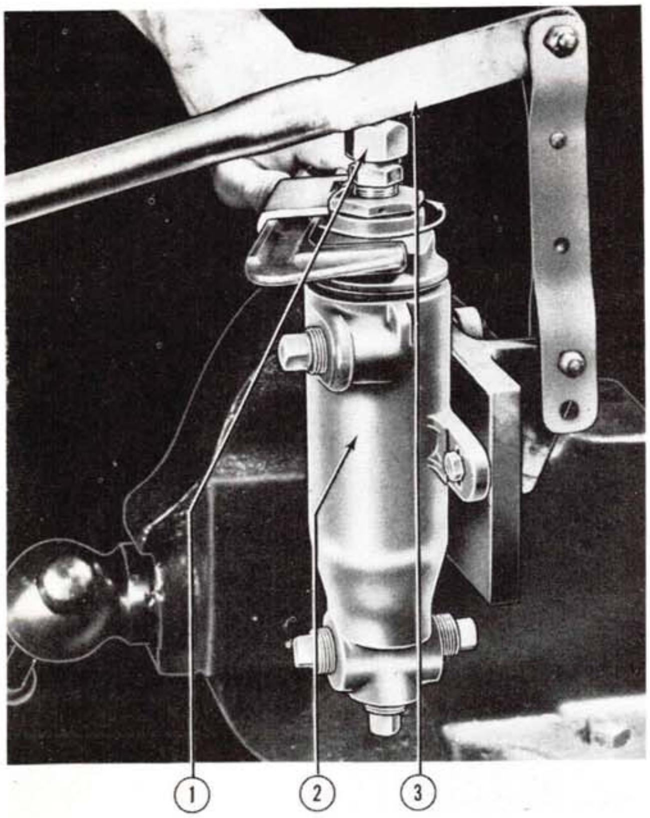


Figure 371—Removal of Regulator End—Early Airplanes

1. Fitting (Screw into Regulator End)
2. Pressure Regulator
3. Arbor Press Handle (Apply Slight Pressure While Unscrewing End)

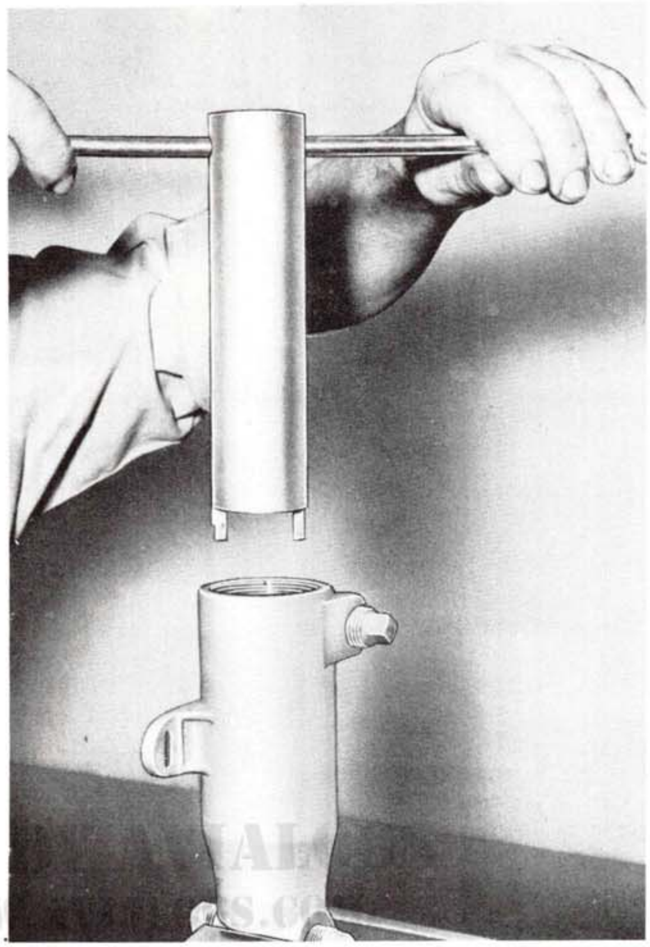


Figure 372—Use of Pressure Regulator Packing Nut Wrench (Service Tool No. K21201)—Early Airplanes

(4) Install the packing rings with care to avoid damage to the packing rings. Use a blunt packing tool of sufficient length to install the packing rings.

(5) Install the spacer. (See figure 367.)

(6) Install the packing nut and stake in place.

Note

> The packing nut and packing must be adjusted so that not more than 6 pounds is required to move the piston up, and not more than 10 pounds is required to move the piston down, when the large spring is removed. The packing must not allow fluid leakage under these conditions.

(7) Install the piston, large spring, and spacing shims. Use the same spacing shims removed from the pressure regulator.

(8) Install the ball check, gasket, and bushing in the top end of the regulator.

(9) Place the top end in place in the pressure-regulator cylinder and, with an arbor press (figure 371), use sufficient force to press the large spring down. Start the end and tighten sufficiently so that the end will not leak when the pressure regulator is installed in the airplane. Install safety wire on bushing and top end.

b. INSTALLATION.

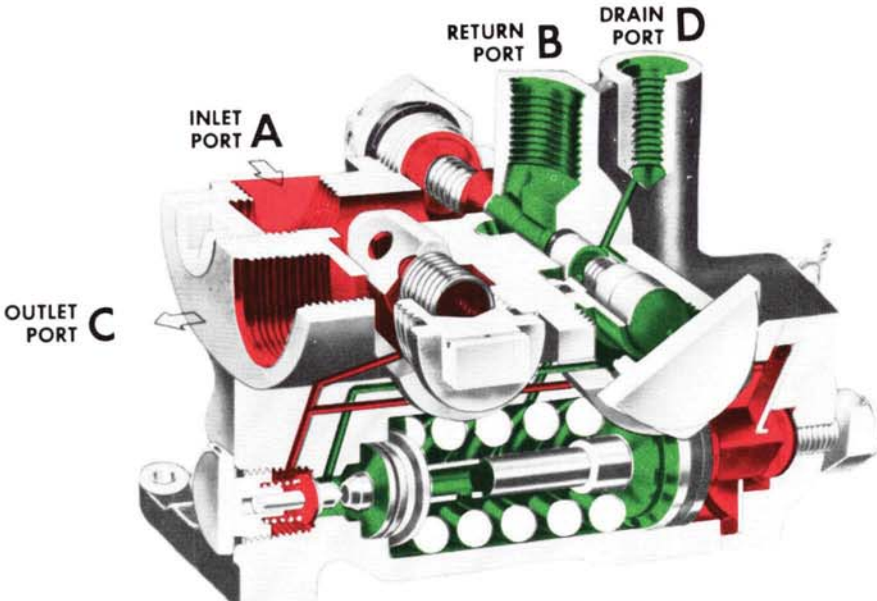
(1) To install the pressure regulator, reassemble the lines and fittings (figure 373) and reinstall in the hydraulic control panel (figure 370).

(2) Check the hydraulic fluid reservoir sight gage for correct fluid level; then test the pressure regulator for fluid leakage and proper functioning.

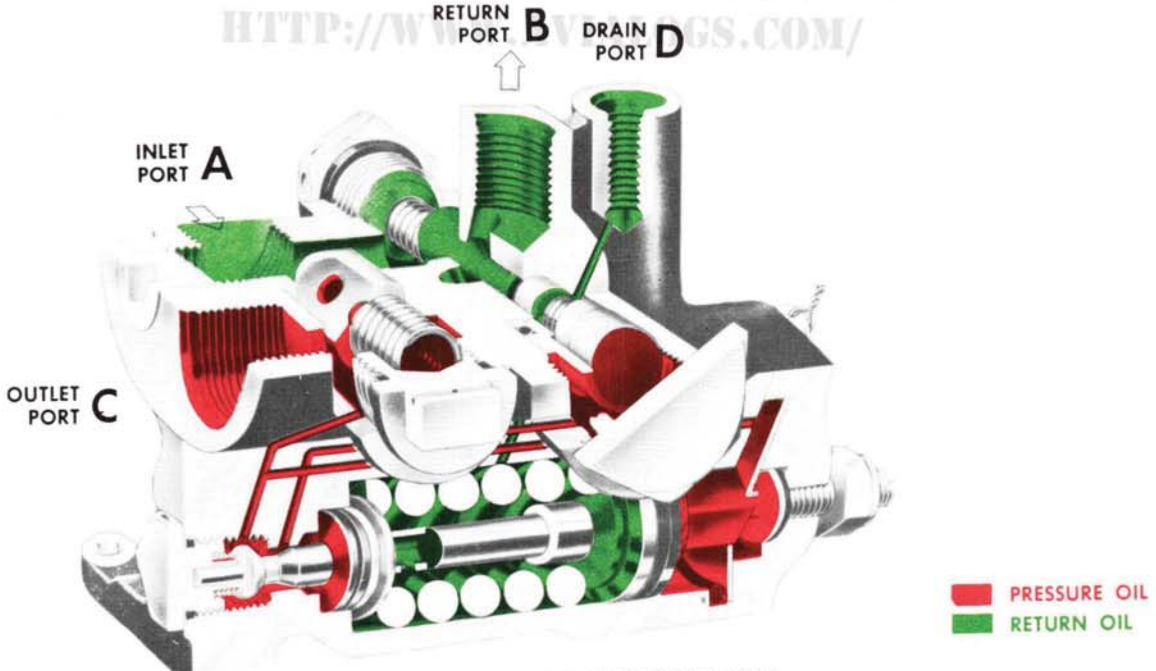
7. MAJOR OVERHAUL.

a. Remove and disassemble the pressure regulator as instructed in paragraph 13.*b.*(6)*(b)*, preceding. When the pressure regulator has been disassembled, inspect all parts for excessive wear or corrosion. Refer to figure 381 for rework tolerances. If rework is impossible, new parts should be installed.

b. Inspect the ball check and seat for pitting or corrosion. If the ball check or seat allows fluid leakage, install new parts and lap to seat according to the instructions in this paragraph *b.*(12)*(f)*. Install new chevron packing. After reassembly test for fluid leaks as specified in figure 369.


RETURN PORT B
DRAIN PORT D
INLET PORT A
OUTLET PORT C

REGULATOR CUT-IN AND PUMP DELIVERY UNDER PRESSURE TO SYSTEM


RETURN PORT B
DRAIN PORT D
INLET PORT A
OUTLET PORT C
🟥 PRESSURE OIL
🟩 RETURN OIL

REGULATOR CUT-OUT AND PUMP DELIVERY BY-PASSED TO RESERVOIR

Figure 372A—Hydraulic Pressure Regulator—Late C-47B Airplanes

TEST PROCEDURE—Late C-47B Airplanes—*(See figure 372A)*

Test Port	*Ports Plugged*	*Test Procedure*	*Max. Leakage*
A	C	1300 psi	1 drop in per min. at Port B None—External
B	A, C	125 psi	None
C	D	1300 psi	1 drop in one hour out any port None—External
Using Test Hookup (See figure 372C)		Valve must unseat at 850 to 900 psi and reseat at 600 psi min.	

(b) LATE C-47B AIRPLANES.
(See figure 372A and 372C.)

1. GENERAL.

a. DESCRIPTION. — Hydraulic pressure regulator is installed on the outboard side of the hydraulic control panel and functions to maintain the system operating pressure between 600 and 875 psi. The pressure regulator is a device for regulating or maintaining the pressure of the airplane's hydraulic system. This is accomplished by operation of a pilot valve assembly which controls the closing and opening of a poppet valve to direct the hydraulic pump's discharge either to the pressure manifold and accumulator until the system pressure of 875 psi has been reached or to the reservoir after the system pressure of 875 psi has been reached. This is accomplished by means of the pilot valve assembly, which is adjusted to operate at 600 psi minimum cut-in and 875 ± 25 psi cut-out pressure. As pressure in the system approaches to cut-out limit, it acts on a piston. When the piston is forced against the spring, the open drain port in the piston rod is closed by contact with the pilot poppet. Then the piston moves farther, opening the pilot poppet. This allows system pressure to pass into the chamber above the bleeder poppet and by-pass piston. Fluid will flow around the bleeder poppet until a certain flow velocity is reached, at which time the pressure differential across the bleeder poppet becomes great enough to cause it to overcome the force of its spring and to seat in the by-pass piston. The by-pass piston immediately operates and opens the by-pass poppet. This takes the load off the engine pump by allowing the fluid to by-pass directly to the reservoir. The cut-out pressure is locked in the system by the system check poppet. When the system pressure decreases to a minimum cut-in pressure of 600 psi, the piston is forced back by its spring until the pilot poppet reseats and the drain port in the open end of the piston rod is opened. This allows the pressure above the bleeder poppet and by-pass piston to return to the reservoir through drain port in the piston. The by-pass poppet is then seated by its spring. This causes the pump out-put to open the system check poppet and recharge the system, thus completing the pressure regulating cycle.

b. TROUBLES AND REMEDIES—LATE C-47B AIRPLANES—*(See figure 372A)*

Trouble	*Probable Cause*	*Remedy*
a. FAILURE TO CHARGE ACCUMULATOR	1. Pilot valve not regulated 2. By-pass poppet stuck open	1. Regulate per instruction 5 of "Test Procedure". 2. Disassemble valve and check for foreign matter or swelled poppet.
b. RAPID CYCLING AND CUTTING IN AT TOO HIGH A PRESSURE	1. Internal leakage	1. Check points 1, 2, 3, 4 for leakage.
c. REGULATOR CUTTING IN AND OUT RAPIDLY AT PROPER CUT-IN AND CUT-OUT PRESSURE	1. Accumulator in system not operating properly 2. Excessive leakage in the hydraulic system	1. Check the accumulator, particularly the air pressure. 2. Check system for some unit open to the return line. Check regulator for leakage past the system check poppet or point 5.

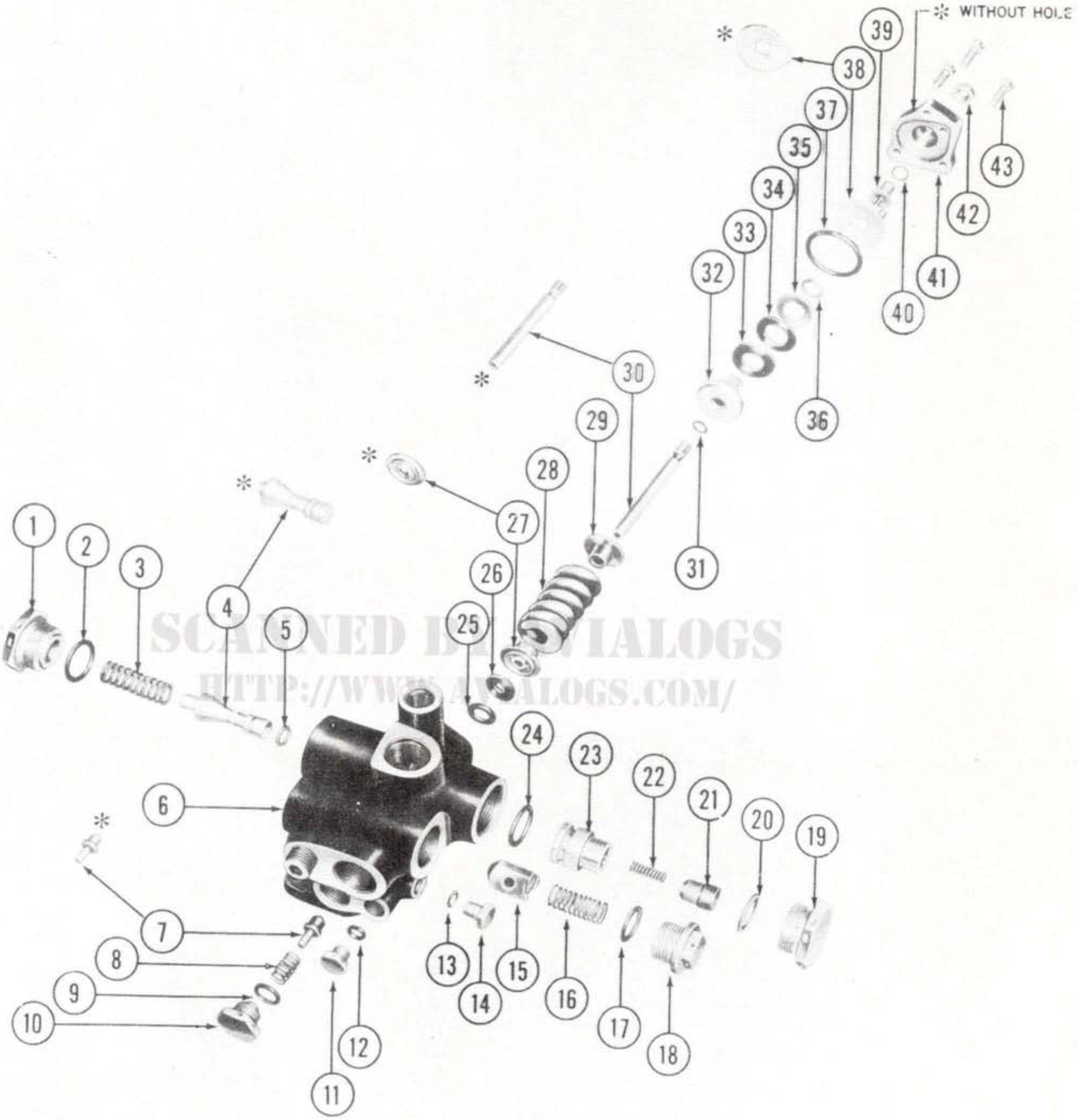

* WITHOUT HOLE
*
39
38
37
35
43
34
42
33
41
32
40
30
*
36
29
*
28
*
27
31
1
26
2
3
4
25
5
24
23
22
6
21
20
19
*
7
8
13
15
9
14
16
17
10
12
18
11

Figure 372B—Hydraulic Pressure Regulator (Late C-47B Airplanes)

Valve Assembly 404906-0-1 shown—later C-47B Airplanes. Parts marked * are for valve Assembly 404906 only—some C-47B Airplanes. Assembly 404906 is interchangeable with and replaced by Assembly 404906-0-1.

1. Plug
2. Packing
3. Spring
4. By-pass Poppet
5. Packing
6. Body
7. Pilot Poppet
8. Spring
9. Gasket
10. Guide
11. Plug
12. Gasket
13. Gasket
14. Plug
15. System Check Poppet
16. Spring, Check Valve
17. Packing
18. Plug
19. Plug
20. Packing
21. Bleeder Poppet
22. Spring
23. By-pass Piston
24. Packing
25. Adapter
26. Packing
27. Retainer
28. Spring
29. Washer
30. Rod
31. Packing
32. Piston
33. Packing
34. Adapter
35. Washer, Packing
36. Snap Ring
37. Packing
38. Plate
39. Driver Pin
40. Packing
41. Cap
42. Nut
43. Cap Screws

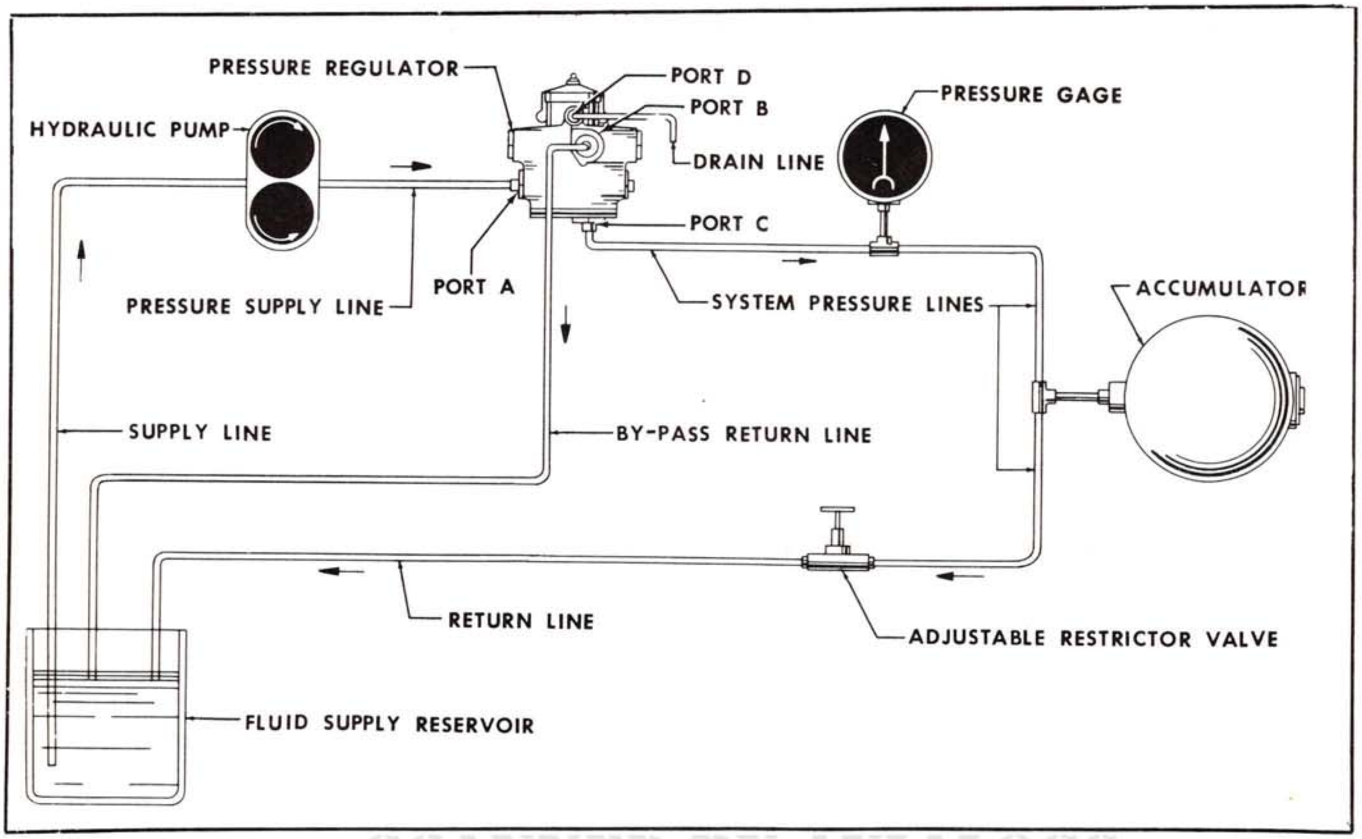

PRESSURE REGULATOR
PORT D
PORT B
HYDRAULIC PUMP
DRAIN LINE
PRESSURE GAGE
PORT C
PORT A
PRESSURE SUPPLY LINE
SYSTEM PRESSURE LINES
ACCUMULATOR
SUPPLY LINE
BY-PASS RETURN LINE
RETURN LINE
ADJUSTABLE RESTRICTOR VALVE
FLUID SUPPLY RESERVOIR

Figure 372C—Schematic Hook-up for Testing Regulator Out of Airplanes

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

(2) Caution must be used when removing parts from the hydraulic control panel assembly. Mark all lines and fittings as removed, so they can be replaced in their original positions on the control panel.

(3) Remove the handle from the hydraulic hand-pump to pressure accumulator shut-off valve.

(4) Disconnect and cap all lines at the connections indicated on figure 372D.

(5) Remove the two nuts and bolts which attach the pressure regulator mount plate to the hydraulic control panel. Remove the pressure regulator assembly from the airplane.

b. DISASSEMBLY.

(1) Do not attempt to disassemble the pressure regulator unless adequate tools are available. When disassembly is undertaken refer to figure 372A and 372B and observe the following procedure.

(a) Cut the lockwire and remove the plug adjacent to the pressure in-let port "A" and take out the spring. Using a long nosed pliers, lightly grasp the end of the poppet and remove.

(b) Cut the lock wire and remove plug opposite plug removed and take out bleeder poppet and spring. The by-pass piston and seal may be pushed out of the unit by using a piece of 3/8 inch dowel.

(c) Remove plug opposite pressure in-let port "A" and take out spring and system check poppet.

(d) Directly beneath port "C" cut lockwire, remove plug, take out spring and pilot poppet.

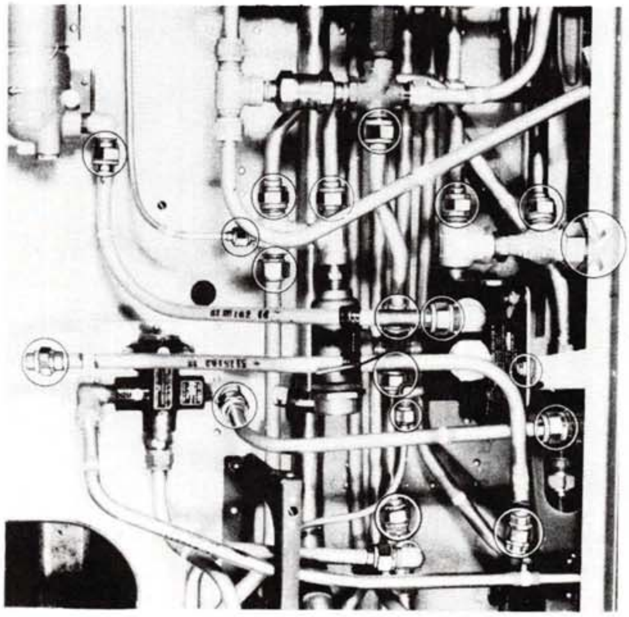


Figure 372D—Removal of Hydraulic Pressure Regulator—Late C-47B Airplanes

(e) Cut lock-wire on cap and remove the three screws and nut holding the cap and take out the plate, driver pin, and seal.

(f) Pull out the piston, unscrew the piston rod from the piston and remove the seal. The packing, washer, and adapter may be removed from the piston by taking off the snap ring.

(g) Remove the guide plug, spring, retainer, packing, and adapter.

Note

It is not necessary to remove any other plugs for disassembly unless there has been evidence of leakage.

c. MAINTENANCE REPAIR OR REPLACEMENT.—If the pressure regulator is damaged or is not functioning properly, it should be replaced with a new or serviceable part.

d. ADJUSTMENTS.—If the pressure regulator does not maintain the proper maximum system operating pressure of 875 ± 25 psi (cut-out pressure), the pressure regulator may be adjusted by turning the driver pin in the cap counterclockwise to increase the cut-out pressure, clockwise to decrease. Then tighten the lock nut to assure no further movement of the driver pin. The cut-in pressure cannot be separately adjusted, and if it is below 600 psi when cut-out pressure is 870 ± 25 psi, the unit should be replaced or inspected for damaged internal parts.

CAUTION

Do not attempt to adjust the driver pin when system pressure is above 500 psi as this will damage the pilot poppet.

e. TESTS BEFORE INSTALLATION.—Refer to paragraph *13.b.*(6)*(b)* preceding for fluid leak tests of the pressure regulator.

f. ASSEMBLY AND INSTALLATION.

(1) Make certain all parts are perfectly clean before assembling the regulator.

(2) Carefully replace the adapter, packing, and retainer in the bore of the pilot valve. Then replace the spring and washer.

(3) Place the packing, adapter, and washer on the piston and secure with a snap ring. Place packing over the piston rod and thread the piston rod into the piston. Place the piston into the unit making certain the end of the piston rod is inside the packing and adapter.

(4) Place the packing over the driver pin and place the driver pin in the cap. Place the plate and packing in the cap and replace on the unit. Replace the lock nut on the driver pin, secure the cap with the three screws and safety wire.

(5) Replace the packing in the groove on the by-pass poppet and replace by-pass poppet in the hole adjacent to pressure port "A." Insert the spring, seal, plug, gasket, and safety wire.

(6) Opposite the plug just assembled, replace packing in the groove in the by-pass piston and replace by-pass piston in the unit. Place spring inside the bleeder poppet and then insert the bleeder poppet in the by-pass piston. Insert the seal and plug.

CAUTION

These plugs are not interchangeable and care should be taken to see that the proper plug is put back in its respective position.

(7) Directly opposite pressure in-let port "A" replace the system check poppet, spring, packing, plug, and safety wire. Directly beneath port "C" replace pilot poppet, spring, gasket, guide plug, and safety wire.

g. INSTALLATION.—To install the pressure regulator, reassemble the lines and fittings and reinstall in the hydraulic control panel (figure 372D).

h. MAJOR OVERHAUL.

(1) Remove and disassemble the pressure regulator as instructed in paragraph 13.*b.*(6)*(b)* preceding.

(2) When the pressure regulator has been disassembled inspect and replace all parts having damage or excessive wear or corrosion and install all new packing, gaskets, and seals.

(3) When overhaul has been completed, reassemble the pressure regulator and test for fluid leaks and adjust for operation as specified in paragraph *13.b.*(6)*(b)* preceding.

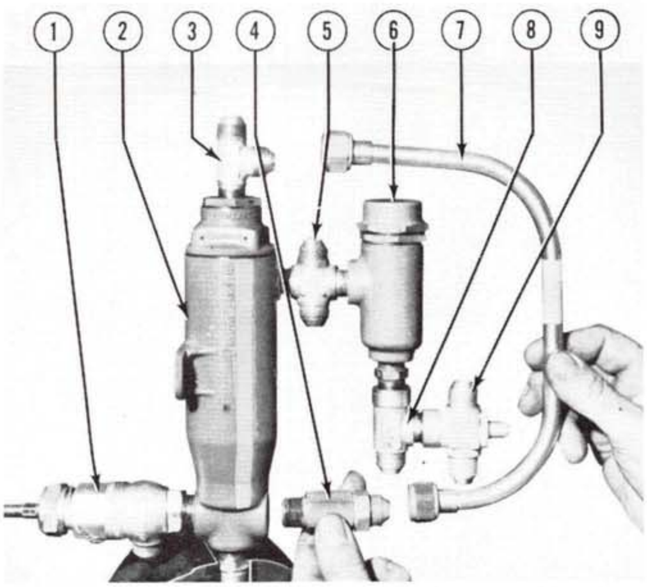


Figure 373—Hydraulic Pressure Regulator and Fittings on C-47A and Early C-47B Airplanes

1. 2130323 Hand Pump to Pressure Accumulator Shut-Off Valve (Handle Removed)
2. 4005434 Hydraulic Pressure Regulator
3. 8-6-8RT-S Parker Tee
4. 8GVFT LH Parker Check Valve
5. 8-8-6-6 KSST Parker Cross
6. 272778-1 Hydraulic System Pressure Relief Valve
7. 5118162-2 Pressure Line
8. 8-6-6-MST-S Parker Tee
9. 8-8-4-6-KOT-S Parker Cross

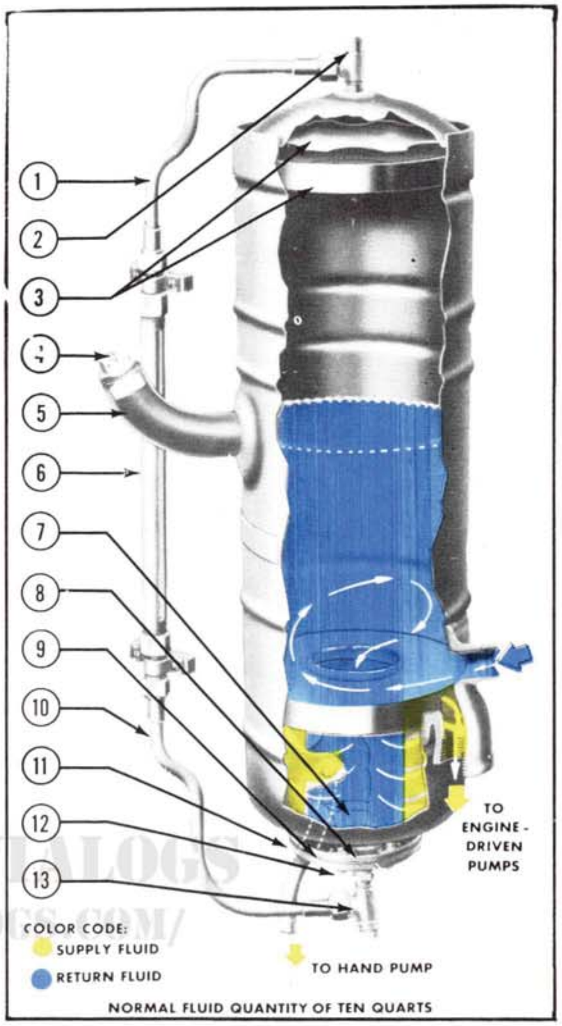

1
2
3
5
6
7
8
9
10
11
12
13
TO ENGINE-DRIVEN PUMPS
COLOR CODE:
SUPPLY FLUID
RETURN FLUID
TO HAND PUMP
NORMAL FLUID QUANTITY OF TEN QUARTS

Figure 374—Hydraulic System Fluid Reservoir Assembly

(Douglas Dwg. No. 4118608)

Item	*Part No.*	*Part Name*	*No. Req*
1	5112589-40	Line	(Ref)
2	6RT-S	Tee (Parker)	(Ref)
3		Baffle Plates (to Prevent Fluid Foam and Agitation)	(Ref)
4	AF907-16	Plug	1
	AN900-16	Gasket	1
	AF995-C-40-6	Lock Wire	1
5	2119771	Filler Neck	1
6	1119802	Sight Gage Assembly	(Ref)
7	2119772	Filter Assembly	1
8	2141595	Flange	1
9	2119769	Gasket	2
10	5112589-41	Line	(Ref)
11	2119774	Cover	1
12	1141526	Stud	8
	AF364-1032	Nut	8
13	AF895-82	Reducer	1
	4-4-6-MRT-S	Tee (Parker)	1
	AF895-71	Plug	1
	AF395-C40-8	Lock Wire	1

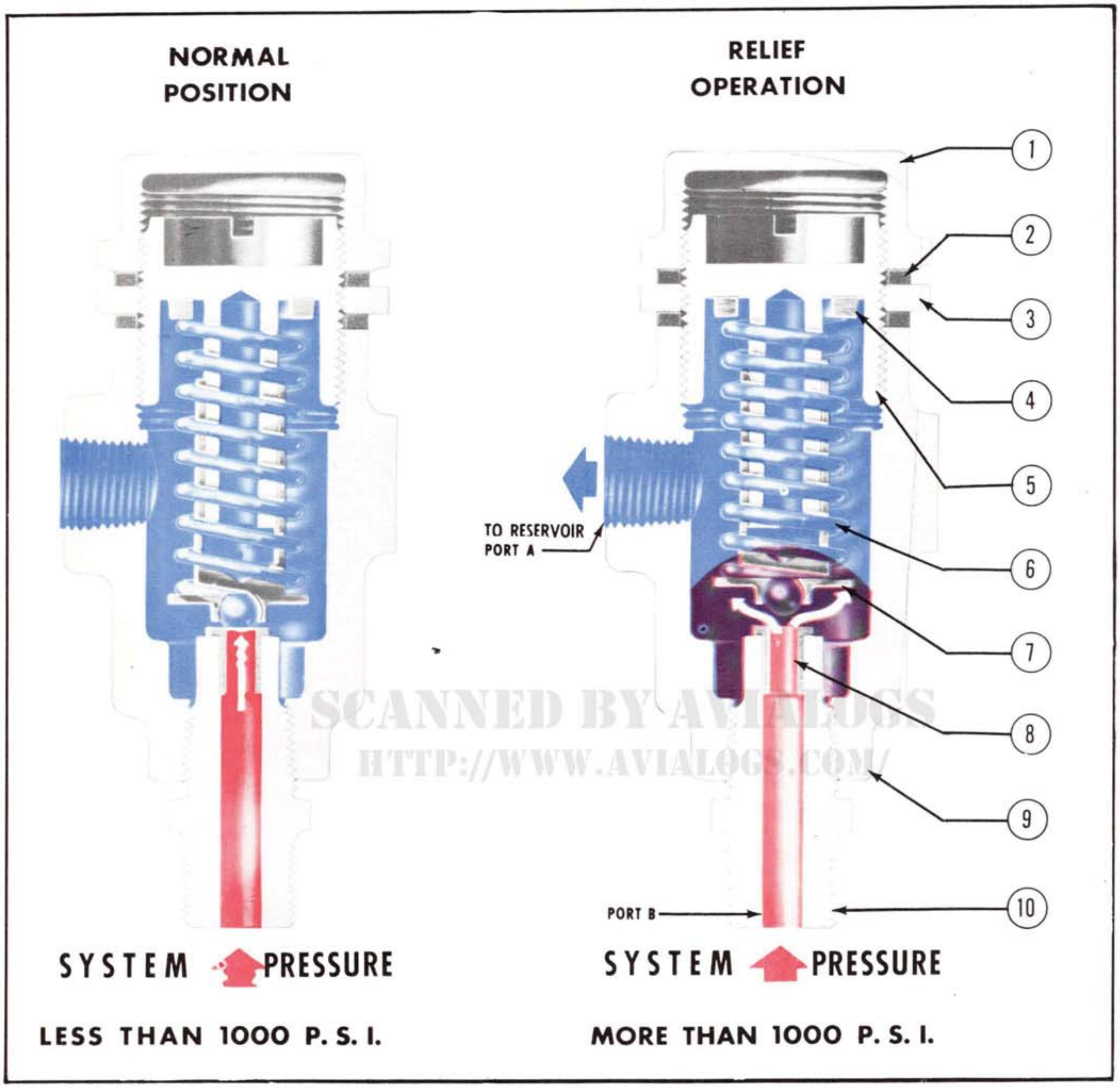


Figure 375—Hydraulic System Pressure Relief Valve Assembly

(7) HYDRAULIC SYSTEM FLUID RESERVOIR. *(See figure 374.)*

(a) DESCRIPTION. — The hydraulic system fluid reservoir is a cylindrical container constructed of aluminum sheets riveted and welded together. The reservoir incorporates a strainer assembly to filter the hydraulic fluid, and a baffle to separate the strained fluid from the fluid returned from the hydraulic system. The reservoir is installed to the right of the hydraulic control panel (figure 360) with a filler neck that extends into the companionway. A sight gage is installed on the upper portion of the hydraulic control panel and indicates the fluid level in the reservoir. The outlet to the engine-driven hydraulic pumps is located above the bottom of the reservoir so that an emergency supply of fluid, available only to hydraulic hand pump, remains in the bottom of the reservoir and cannot be drawn out by the engine-driven pumps. The outlet for the hydraulic hand pump is located at the bottom of the reservoir sump. The capacity of the hydraulic reservoir when filled to the top arrow on the sight gage is 10 U.S. (8.3 Imperial) quarts. Seven U.S. (5.8 Imperial) quarts are available to the engine-driven hydraulic pumps while the remaining 3 U.S. (2.5 Imperial) quarts in the res-

KEY TO FIGURE 375

(Douglas Dwg. No. 272778-1)

TEST PROCEDURE

Test Port	*Test Pressure*	*Max. Leakage*
A	225 psi	10 drops per hour at "B." No other leakage
B	Opening pressure— 1000 ± 50 psi	———
B	Reseat pressure— 950 ± 50 psi	1 drop per hour

Item	*Part No.*	*Part Name*	*No. Req*
1	147113	Cap	1
2	1161144-20	Gasket	2
3	138759	Lock Nut	1
4	143908-16D-28-125	Washer (Use if Necessary to Obtain Proper Adjustment)	1
5	138758	Guide	1
6	138757	Spring	1
7	1000859	Stem Assembly (Includes 1/4 Diameter Steel Ball)	1
8	1070078	Bushing	1
9	238754-2	Housing	1
10	1016496-1	Body (Items 9 and 10 Make Up 1016496 Seat Assembly)	1

ervoir sump are available only to the hydraulic hand pump. Sufficient space is provided at the top of the reservoir to allow for thermal expansion. Agitation and foaming of the hydraulic fluid is prevented by baffle **plates in the top of the reservoir. A vent line is connected to the top of the reservoir. The reservoir will be filled with hydraulic fluid, Specification No. MIL-O-5606. Instructions for filling the reservoir will be found in paragraph 13.*b*.(1), this section.**

Note

When the airplane is in flight and hydraulic units are being operated the fluid vortex within the hydraulic reservoir may draw all the fluid out of the fluid level sight gage and the fluid level will indicate an empty reservoir. However, the fluid vortex usually will subside when no hydraulic units are being operated and the fluid level will rise in the sight gage.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

b. Remove the plug in the tee at the bottom of the reservoir and drain the hydraulic fluid into a clean container.

c. Disconnect and cap all lines leading to the reservoir.

d. Remove the strap assembly that secures the reservoir and remove the reservoir from the airplane.

2. DISASSEMBLY.—Remove the eight studs that attach the bottom cover and strainer flange to the bottom flange of the reservoir. Remove the reservoir cover, gaskets, and strainer assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. TO CLEAN THE RESERVOIR.

a. Remove and disassemble the hydraulic reservoir as described in this paragraph *b*.(7)*(b)*.

b. Clean the strainer with a brush and clear gasoline.

c. Flush the reservoir with clear gasoline and allow the reservoir to dry thoroughly. Inspect the tank interior for any remaining foreign material and again flush the reservoir with clean gasoline if any foreign material is detected.

2. Small holes or cracks in the hydraulic reservoir may be welded.

3. Small holes or tears in the strainer assembly may be soldered.

4. A damaged or leaking fluid level sight gage should be replaced with a new part.

5. A damaged hydraulic reservoir should be replaced with a new part.

(d) TESTS BEFORE INSTALLATION.—After the hydraulic reservoir is reassembled, apply 15 psi internal pressure with all outlets plugged to test the reservoir for leakage. No leakage is permissible.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the hydraulic reservoir, refer to figure 374.

2. INSTALLATION.—To install the hydraulic reservoir reverse the removal procedure as outlined in this paragraph 13.*b*.(7)*(b)*, preceding.

(f) MAJOR OVERHAUL. – Follow the same procedure as given in removal and disassembly and maintenance repair, preceding.

(8) HYDRAULIC SYSTEM PRESSURE RELIEF VALVE. *(See figure 375.)*

(a) DESCRIPTION.–The system pressure relief valve functions to protect the hydraulic system from excessive fluid pressure when the hydraulic pressure regulator fails to operate. The valve is located adjacent to the pressure regulator in the hydraulic control panel assembly (figure 362). The valve consists of an aluminum-alloy housing that encloses a spring-loaded stem and ball assembly with the ball seating on a steel bushing. If the hydraulic pressure regulator fails to operate properly and the system pressure increases to 1000 ± 50 psi, the system pressure relief valve is opened and the excess fluid flows through the system pressure relief valve to the return line to the hydraulic fluid reservoir. The valve ball is reseated by the spring when the pressure decreases to 950 ± 50 psi. The valve has two ports: one is connected to the return line to the hydraulic reservoir; the other is connected to the pressure regulator.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

b. Remove the handle from the hand pump to pressure accumulator shut-off valve.

c. Disconnect and cap all connections as indicated in figure 370.

d. Remove the bolts and nuts that attach the pressure regulator to the control panel and remove the pressure regulator and fittings which include the system pressure relief valve.

2. DISASSEMBLY.

a. Remove the system pressure relief valve from the pressure regulator. Remove the tee and cross from the bottom port of the valve.

b. Remove the cap and lock nut from the system pressure relief valve. (See figure 375.)

c. Remove the guide, spring, and stem assembly from the valve housing. Remove the seat assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. External leakage of the valve may be caused by defective or damaged cap gaskets which should be replaced with new parts.

2. Replace damaged or inoperative system pressure relief valve with a new part.

(d) ADJUSTMENTS.

1. If it is impossible to increase the fluid pressure in the hydraulic pressure accumulator to 875 psi by operating the hydraulic hand pump with the hand pump to pressure accumulator shut-off valve open, carefully inspect the pressure regulator, hand pump, and connecting lines for fluid leaks. If no fluid leaks are discovered it is possible that the system pressure relief valve is out of adjustment, allowing fluid to return to the reservoir before the normal maximum operating pressure is attained.

2. Adjust the spring release pressure so that the valve opens when the system pressure increases to 1000 ± 50 psi and closes when the system pressure decreases to 950 ± 50 psi. The spring tension may be increased or decreased by tightening or loosening the stem guide, after loosening the lock nut. (See figure 375.) After the valve has been adjusted properly, tighten the lock nut and replace the cap.

(e) TESTS BEFORE INSTALLATION.–Refer to figure 375 for fluid leak tests of the system pressure relief valve.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.–To assemble the system pressure relief valve, reverse the disassembly procedure as given in this paragraph, *b.*(8)*(b)* and refer to figure 375. Be sure all parts are clean before assembling the valve.

2. INSTALLATION.–To install the system pressure relief valve reverse the removal procedure as given in paragraph 13.*b.*(8)*(b)* preceding, and refer to figures 370 and 373.

(g) MAJOR OVERHAUL.

1. Remove and disassemble the valve according to the instructions in this paragraph 13.*b.*(8)*(b)* preceding.

2. Refer to figure 382 for rework tolerances of the system pressure relief valve. Check all parts for evidence of excessive wear, pitting, and corrosion. Install new parts if necessary.

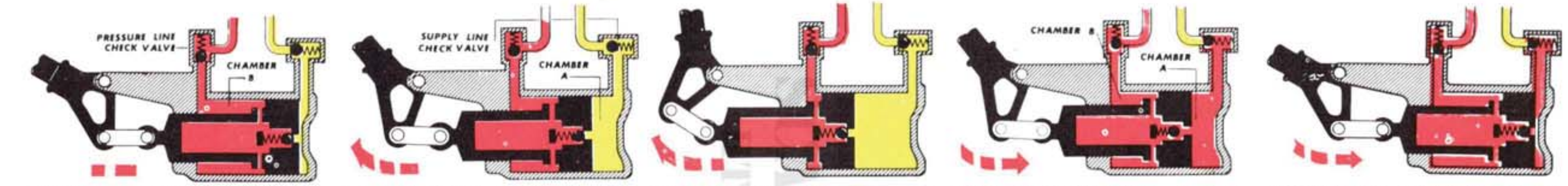
3. If a new bushing is installed, tin the seat body with solder, Federal Specification No. QQ-S-571, grade A (Navy 46-S-14, grade A), before pressing in the bushing. Lap the bushing lightly with ⅜-inch diameter ball and finish the lap with a ¼-inch diameter ball to provide a round hole and sharp edge for the ball seat.

4. Check the stem assembly to see that the steel ball turns freely in its socket.

5. When rework has been completed, reassemble the valve and test for fluid leaks as specified in figure 375.

(9) HYDRAULIC HAND PUMP. *(See figures 376 and 377.)*

(a) DESCRIPTION. – The hydraulic hand pump, located at the bottom of the hydraulic control panel (figure 361), is a double-acting, piston-type pump that supplies fluid pressure with each stroke of the pump handle. The pump mechanism consists of a


PRESSURE LINE CHECK VALVE
CHAMBER B
SUPPLY LINE CHECK VALVE
CHAMBER A
CHAMBER B
CHAMBER A

PUMP HANDLE LEFT IN "DOWN" POSITION: Check valves are closed preventing fluid flow.

COLOR CODE:

- 🟨 **FLUID SUPPLY**
- 🟥 **FLUID PRESSURE**

UP STROKE OF HANDLE: As pump piston moves outward, closed piston check valve traps fluid within piston and forces fluid from Chamber "B" past pressure line check valve. Fluid is drawn through supply line check valve into Chamber "A."

UP STROKE COMPLETED: Pump piston is at extreme outward end of cylinder. Check valves are closed preventing back flow through pump.

DOWN STROKE OF HANDLE: As piston moves inward, fluid pressure closes the supply line check valve, and the fluid volume displaced within Chamber "A" can only be forced into Chamber "B." Because of piston rod displacement, Chamber "B" has less volume than "A"; therefore piston movement inward forces fluid past pressure line check valve into system.

DOWN STROKE COMPLETED: Pump piston is at extreme inward end of cylinder. Check valves are closed. Fluid under pressure in pump is trapped there by check valves.

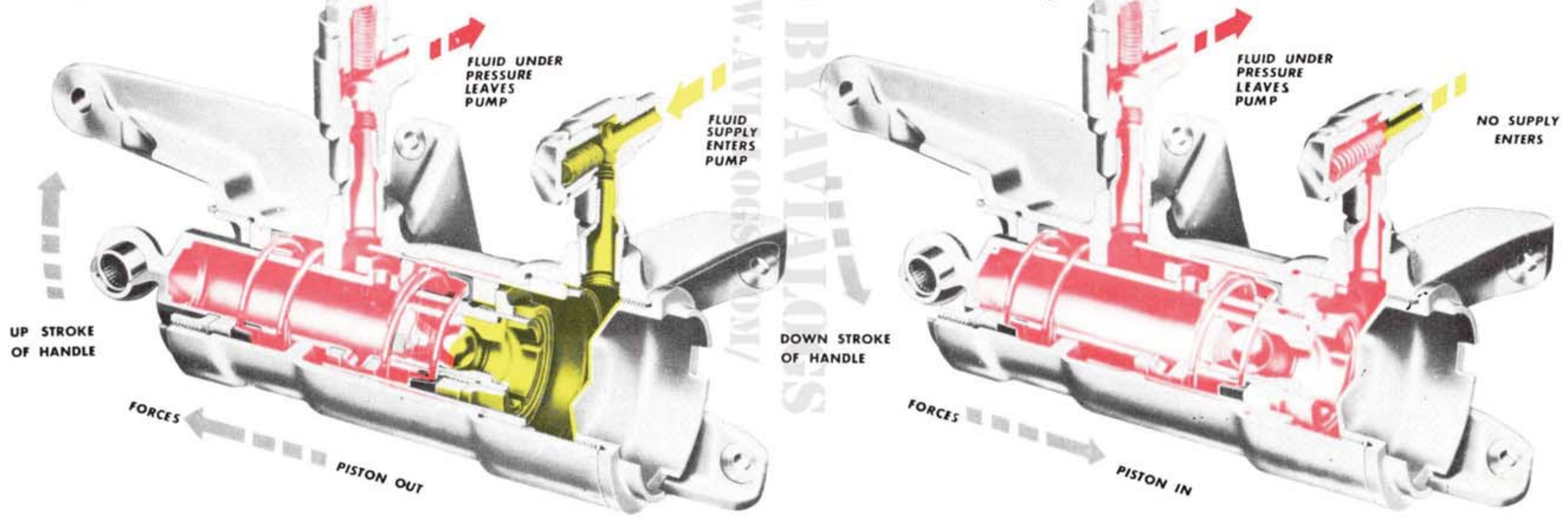

FLUID UNDER PRESSURE LEAVES PUMP
FLUID SUPPLY ENTERS PUMP
UP STROKE OF HANDLE
FORCES
PISTON OUT
DOWN STROKE OF HANDLE
FLUID UNDER PRESSURE LEAVES PUMP
NO SUPPLY ENTERS
FORCES
PISTON IN

Figure 376—Operation of Hydraulic Hand Pump

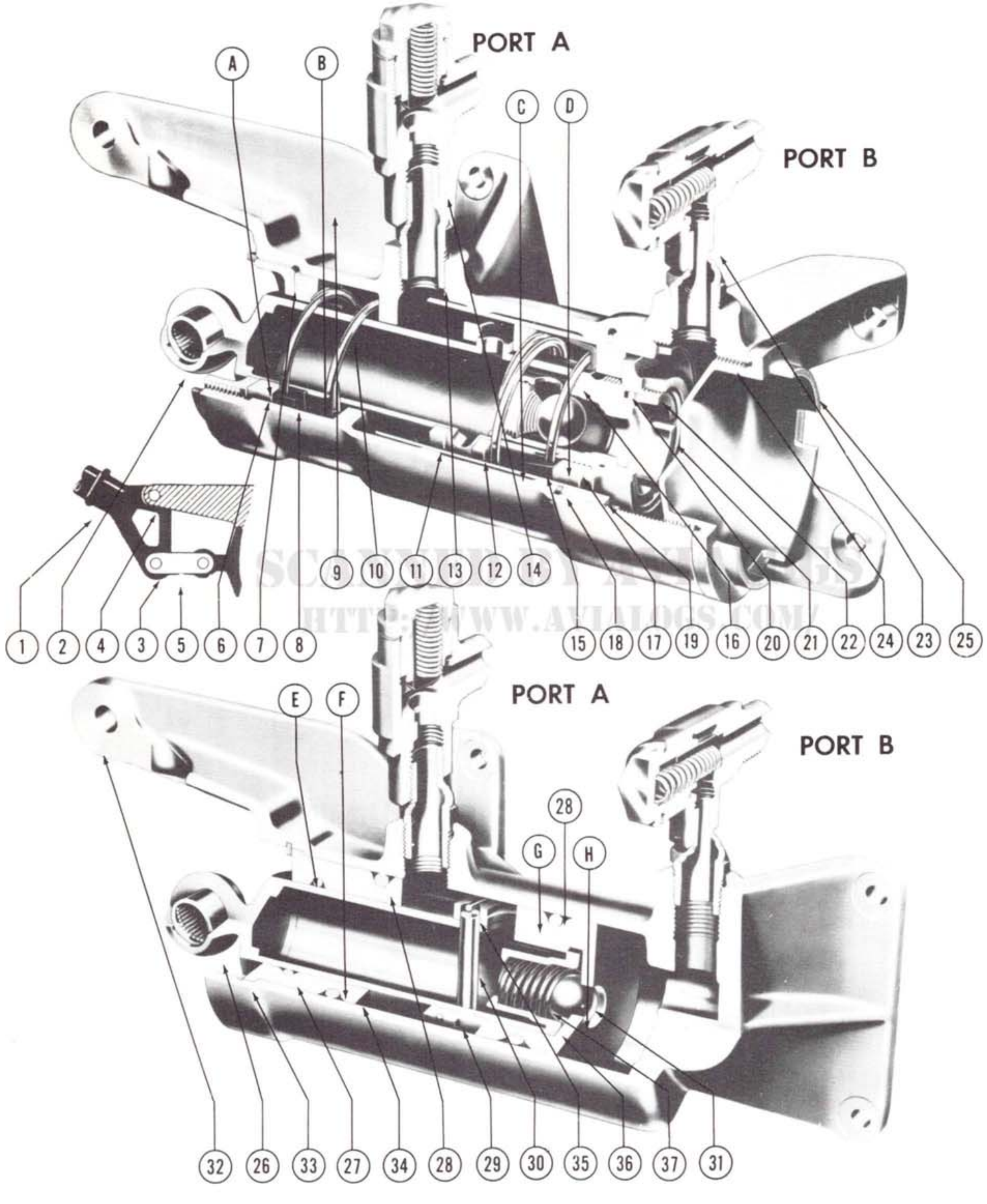

PORT A
A
B
C
D
PORT B
9
10
11
13
12
14
1
2
4
3
5
6
7
8
15
18
17
19
16
20
21
22
24
23
25
PORT A
E
F
PORT B
28
G
H
32
26
33
27
34
28
29
30
35
36
37
31

Figure 377—Hydraulic Hand Pump Assembly

KEY TO FIGURE 377
TEST PROCEDURE

Port A	*Port B*	*Position*	*Handle Load*	*Flow*	*External Leakage*	*Max. Allow. Handle Creep*
Connec to 800 psi relief valve	Connect to reservoir	Operate Slowly	190 lbs. Max.	———	———	—
Open	Connect to reservoir	Operate 120 cycles per minute	———	198 cu in. per minute	———	———
Plugged	Connect to reservoir	Piston extended	240 lbs	———	1 drop in 24 hours	1 inch per hour
Plugged	Connect to reservoir	Piston retracted	195 lbs	———	1 drop in 24 hours	1 inch per hour

Item	*Part No.*	*Part Name*	*No. Req*
1	2118975	Handle Assembly	1
	3118957	Handle	1
	1118938	End	1
	2118956	Socket	1
	B-88	Torrington Needle Bearing (Press in Place)	2
	117425-8D-017	Spacer	1
	B-812	Torrington Needle Bearing (Press in Place)	1
	AN3-21A	Bolt	2
	AF365-1032	Nut	2
	AN960-10	Washer	2
2	2119015	Shaft Assembly (Includes B-812 Torrington Needle Bearing)	1
3	111904-6-111	Bolt	2
	1118969-2	Spacer	2
	AN320-6	Nut	2
	AN960-616	Washer	2
	AN380-3-3	Cotter	2
4	111904-6-223	Bolt	1
	1118969-1	Spacer	1
	AN320-6	Nut	1
	AN960-616	Washer	1
	AN380-3-3	Cotter	1
5	1118970	Link	2
6	1118942	Ring	1
7	1118934	Packing Nut	1
	AF995-47-3	Lock Wire	1
8	1036848-6D-116	Packing Cup	1
9	5119000	Housing	1
10	1118878	Spring	1
11	1118943	Spacer	1
12	1118935	Ring	1
13	AF895-92	Hex Nipple	2
14	8AGVDT	Parker Check Valve	1

KEY TO FIGURE 377—Continued

Item	*Part No.*	*Part Name*	*No. Req*
15	1036848-6D-116	Packing Cup	1
16	1118878	Spring	1
17	1118942	Ring—Packing	1
18	143908-212TC218-065	Washer	1
19	1118949	Liner	1
20	143908-104TC110-065	Washer	1
21	1118936	Valve Assembly	1
	Consists of:		
	AN380-2-2	Cotter	1
	1118799	Seat	1
		5/8 Diameter Steel Ball	1
	1118800	Spring	1
	1118801	Plug	1
22	1118937	Collar	1
23	8AGVMT	Parker Check Valve	1
24	143908-224SR300-093	Washer	1
25	1118895	End	1
	AF995-47-6	Lock Wire	1
26	2056	Rod Assembly	1
27	AN6227-25	Ring	1
28	AN6227-29	Ring	2
29	2057	Head	1
30	2076	Pin	1
31	5/8	Precision Ground Stainless Steel Ball	1
32	2053	Housing	1
33	NAS 50-218	Snap Ring	1
34	2059	Gland	1
35	2077	Retainer Ring	1
36	2058	Ball Retainer	1
37	2075	Spring	1

Rework Tolerances

A. Diametral clearance between spacer and piston should not exceed .010. Rework to .0005 to .0025 clearance by replacing spacer or chrome plating piston.

B. Manufacturing dimension of piston 1.4985 to 1.4995 OD. Do not grind piston more than .020 undersize. Pistons may be hard chrome plated to a thickness of .010 on a radius.

C. Manufacturing dimension of liner 2.264 to .252 ID. Because of strength requirements the inside diameter of the liner should not be honed larger than 2.272.

D. Diametral clearance between spacer and liner should not exceed .010. Rework to .001 to .004 clearance by replacing spacer.

E. Diametral clearance between packing gland and piston rod should not exceed .006. Rework to .002 to .004 clearance by replacing packing gland or chrome plating piston.

F. Manufacturing dimension of piston rod 1.371 to 1.373 OD. Do not grind piston rod more than .020 undersize. Pistons may be hard chrome plated to a thickness of .010 on a radius. Manufacturing dimension of piston gland 1.3745 to 1.3755 ID.

G. Diametral clearance between piston head and cylinder should not exceed .006. Rework to .002 to .004 clearance by replacing or chrome plating piston head.

H. Manufacturing dimensions of cylinder 1.999 to 2.001 ID. Manufacturing dimensions of piston head 1.996 to 1.998 OD.

piston and check valve assembly which operates in a pump housing. Check valves also are located in the supply and pressure ports of the pump to maintain the proper direction of flow in the pump. On the upward stroke of the hand-pump handle the piston assembly is pulled forward, forcing the fluid in the forward chamber into the pressure port and drawing fluid into the aft chamber of the pump. On the downward stroke of the hand-pump handle the piston is moved aft, unseating the ball check in the piston and forcing part of the fluid in the aft chamber of the pump into the pressure port. The hydraulic hand pump serves two functions: it supplies hydraulic fluid pressure in flight when the engine-driven pumps fail; it supplies hydraulic fluid pressure for operation of hydraulic units when the airplane is on the ground and it is not convenient to operate the engines. If it is desired to increase pressure in the hydraulic pressure accumulator by operating the hand pump when the airplane is on the ground, open the hand pump to pressure accumulator shut-off valve located on the hydraulic control panel (See figure 361). The shut-off valve *must* always be closed in flight so that the hydraulic units are actuated directly by operation of the hand pump. Hydraulic fluid is supplied to the hand pump from the bottom of the hydraulic fluid reservoir. The reservoir is so designed that the engine driven pump can never take out the emergency supply of fluid reserved for the hand pump.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

b. Disconnect the suction and pressure lines from the external check valves.

c. Remove the bolts that attach the hand pump to the hydraulic control panel (figure 361) and remove the pump from the airplane.

d. Plug the suction and return lines.

2. DISASSEMBLY.

a. C-47A and early C-47B airplanes—Disassembly of the hand pump should not be undertaken in the field but if disassembly is attempted refer to figure 377 and observe following procedure.

(1) Remove the handle assembly from the pump by removing the attaching bolts.

(2) Cut the lock wire and unscrew the collar end by using service tool No. K26409.

(3) Push the piston assembly out the rear end of the pump.

(4) Disassemble the check valve assembly in the piston assembly.

(5) Cut the lock wire and remove the piston shaft packing nut by using service tool No. K26410 (figure 378). To fabricate service tools No. K26409 and K26410 refer to figure 102.

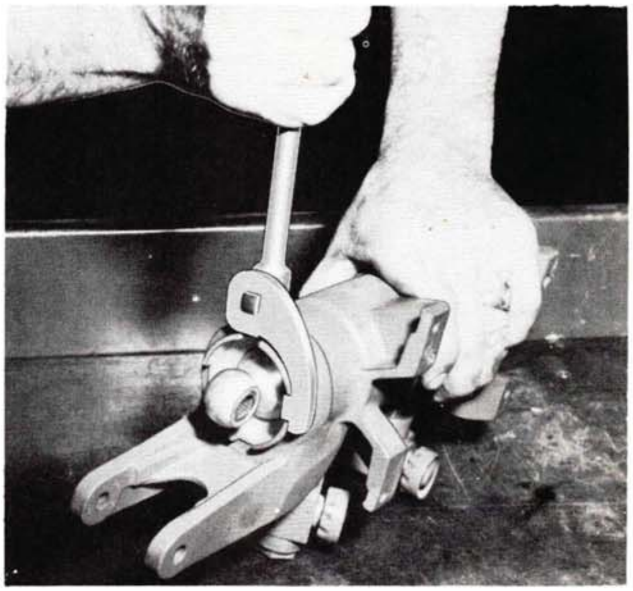


Figure 378—Use of Hydraulic Hand Pump Packing Nut Spanner Wrench (Service Tool No. K26410)

(Figure 379 deleted revision of 10 June 1945.)

(6) Remove the packing ring, packing cup, and spring.

(7) Remove the check valves from the supply and pressure ports of the hand pump.

b. Late C-47B Airplanes—Disassembly of the hand pump should not be undertaken in the field but if disassembly is attempted refer to figure 377 and observe the following procedure.

(1) Remove the handle assembly of the hand pump by removing the attaching bolts.

(2) Remove snap ring.

(3) Pull piston assembly and packing gland from cylinder.

(4) Slip packing gland off of piston assembly.

(5) Remove retaining ring and retaining pin from piston assembly.

(6) Remove piston head and disassemble ball check.

(7) Remove the check valves from the supply and pressure ports of the hand pump.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—A damaged hand pump or one that is not functioning properly should be replaced with a new or serviceable hydraulic hand pump.

(d) TESTS BEFORE INSTALLATION.—Refer to figure 377 for fluid leak tests of the hydraulic hand pump.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the hydraulic hand pump reverse the disassembly procedure as given in this paragraph *b.*(9)*(b)* and refer to figure 377. Be sure all parts are clean before assembly.

2. INSTALLATION.—To install the hydrau-

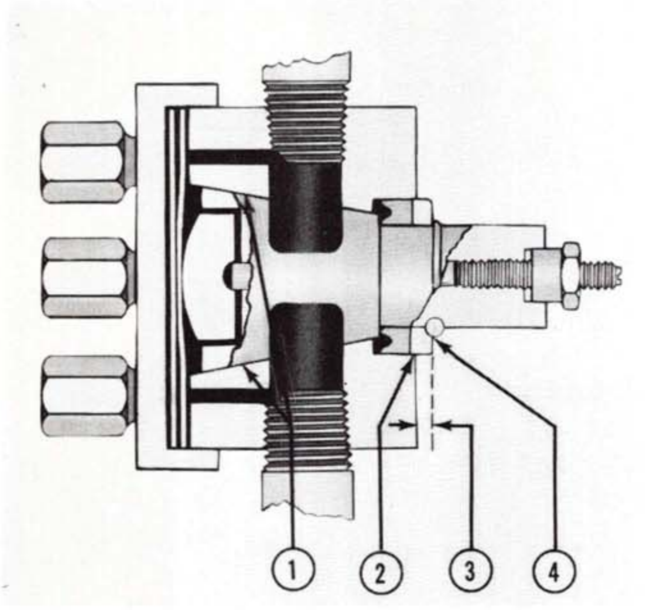


Figure 380—Rework Tolerances of Landing Gear, Wing Flap, and Engine-Driven Pump Control Valves

1. Do not chrome plate lapped surface of plug.

2. If diametral clearance between spacer and body exceeds .015, rework to .002 to .008 by replacing spacer. (Maximum clearance for engine-driven pump selector valve is .010.)

3. Spacer must overlap body a minimum of .020. Replace plug or body to increase overlap.

4. If diametral clearance between spacer and plug exceeds .015, rework to .004 to .007 by replacing spacer or chrome plating plug. (Maximum clearance for engine-driven pump selector valve is .010.)

Note

Lap plug into body when either plug or body is replaced.

lic hand pump, bolt the hand pump to the hydraulic control panel. Connect the lines leading to the hand pump check valves.

(f) MAJOR OVERHAUL.

1. Remove and disassemble the hand pump according to the instructions given in paragraph 13.*b.*(9)*(b).* (See figure 377.)

2. Inspect all parts for wear installing new parts if necessary. Refer to figure 377 for rework tolerances.

3. Inspect the valve poppets or balls and valve seats in the check valves for evidence of wear. If these parts are only slightly worn they may be reconditioned according to the instructions in this paragraph 13.*b.*(12)*(f)* following.

4. Replace all packing cups and washers with new parts. On later airplanes replace all "O" rings.

5. Assemble the hand pump after rework is complete, and test for fluid leaks as specified in figure 377.

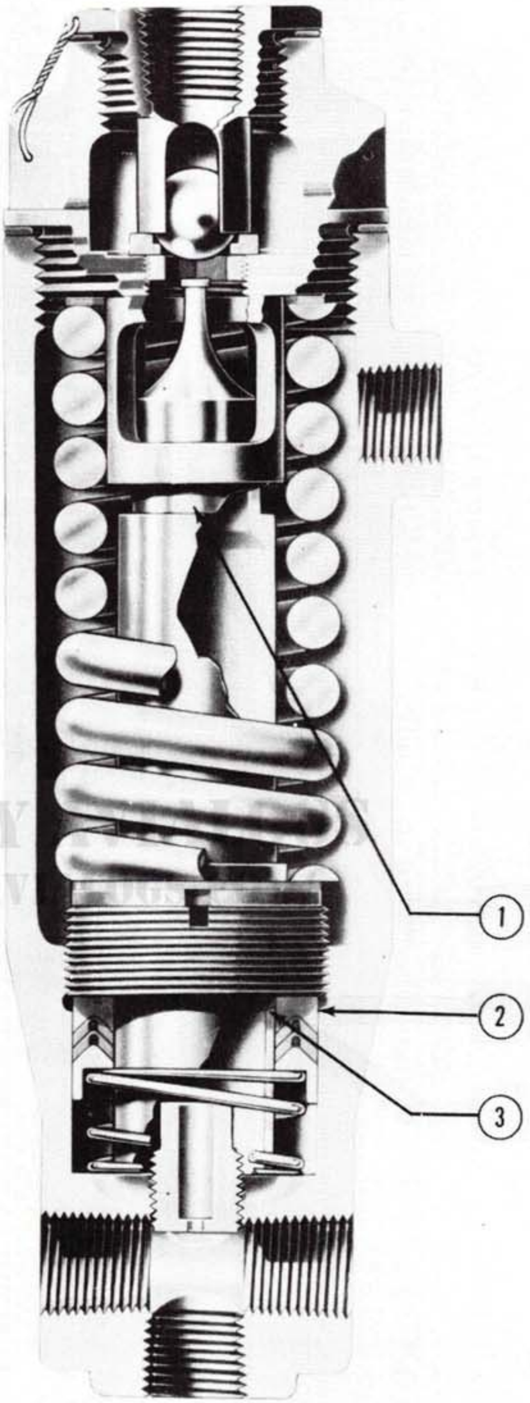


Figure 381—Rework Tolerances of Hydraulic System Pressure Regulator

1. Diametral clearance between piston and end should not exceed .020. Rework to .0035 to .0065 by chrome plating piston or replacing end. Piston may be chrome plated a maximum of .020 on a diameter.

2. Diametral clearance between spacer and housing should not exceed .020. Rework to .002 to .008 by replacing spacer.

3. Diametral clearance between spacer and piston should not exceed .020. Rework to .002 to .005 by replacing spacer.

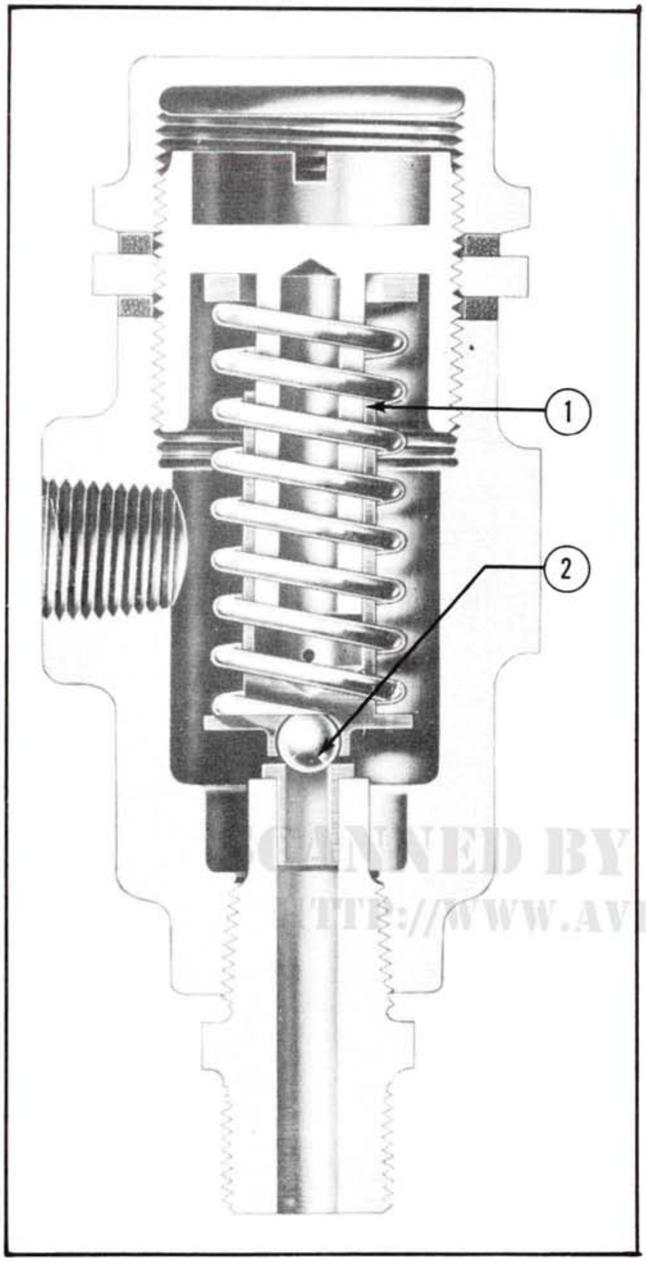


Figure 382—Rework Tolerances of Hydraulic System Pressure Relief Valve

1. Diametric difference between guide and stem should not exceed .034. Rework to .020 ± .002 by replacing stem or guide.
2. Ball must rotate freely in socket.

(10) HAND PUMP TO PRESSURE ACCUMULATOR SHUT-OFF VALVE.

(See figure 383.)

(a) DESCRIPTION.—The hand pump to pressure accumulator shut-off valve is located at the bottom of the pressure regulator with the valve handle located near the center of the hydraulic control panel (figure 361). The valve provides a bypass around the check valve in the pressure manifold if it is desirable to increase hydraulic pressure in the pressure accumulator by operating the hand pump when the airplane is on the ground and the engines are not operating. The valve consists essentially of a valve plug, housing, and valve handle. A small hole is drilled through the valve plug or the valve plug seat to provide a means of relieving excess fluid pressure existing in the pressure manifold. This bleed hole does not affect the operation of the hand pump. In flight the hand pump to pressure accumulator shut-off valve must be closed and safetied with lock wire so that the hydraulic units may be actuated directly by operation of the hand pump.

Note

Two types of valves have been used on the airplane but the valves are interchangeable. The main differences between the two valves are the handles, shape of the valve plugs, valve plug seats, and location of the bleed holes.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

b. Disconnect and cap the hydraulic line leading to the valve.

c. Unscrew the valve from the bottom of the hydraulic pressure regulator and remove the valve from the airplane.

2. DISASSEMBLY.—To disassemble the valve refer to figure 383.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. If the bleed hole in the valve becomes clogged, it will be necessary to disassemble the valve and clean the bleed hole.

2. If the hand pump to pressure accumulator shut-off valve is damaged or is not functioning properly, replace the valve with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.—Refer to figure 383 for fluid leak tests of the valve.

(e) ASSEMBLY AND INSTALLATION.

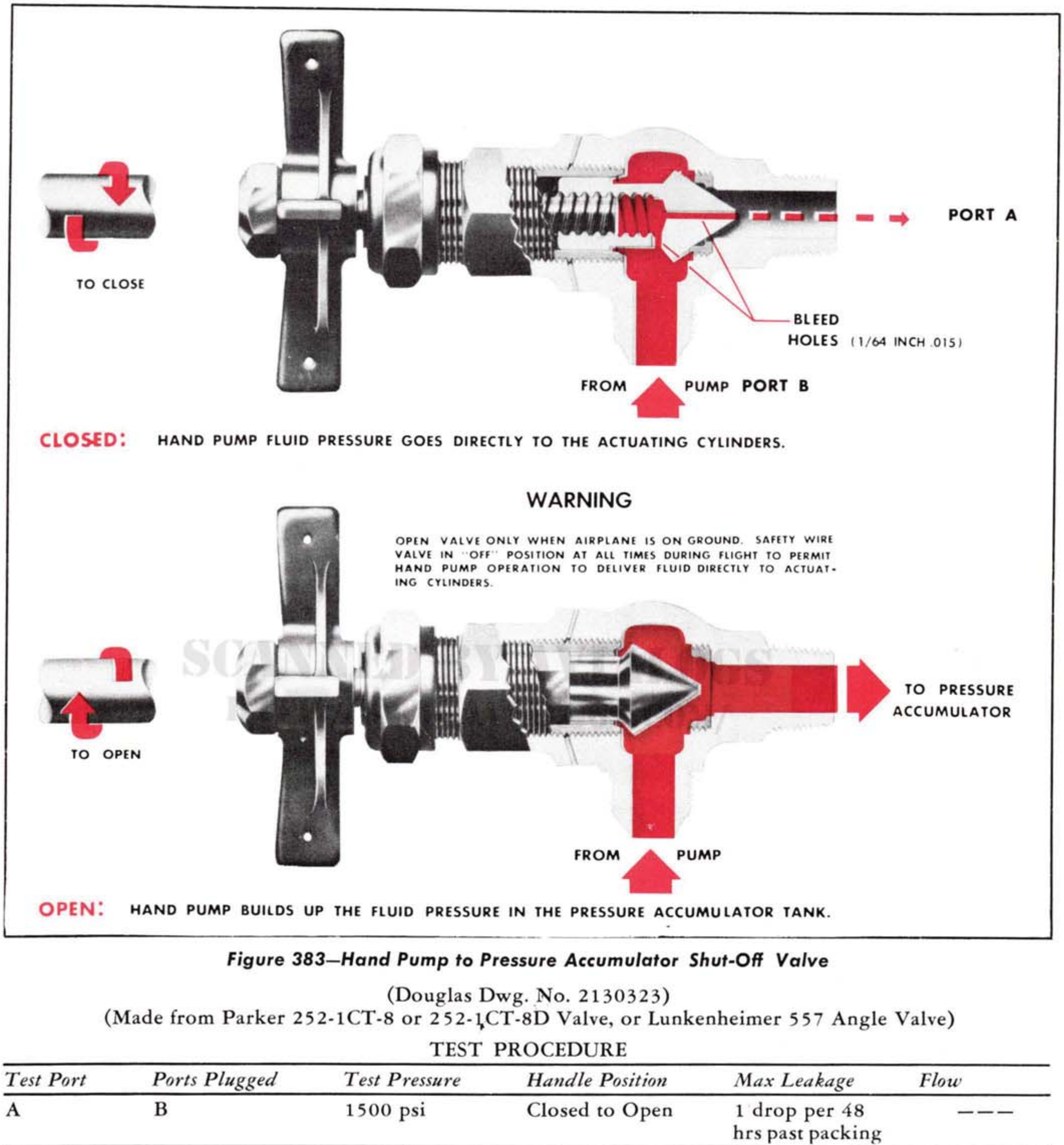
1. ASSEMBLY.—Be sure all parts are clean. To assemble the valve, refer to figure 383.

2. INSTALLATION.—To install the valve, reverse the removal procedure.

(f) MAJOR OVERHAUL.

1. Remove and disassemble the valve in accordance with preceding instructions.

2. If the valve plug allows fluid leakage, the plug or seat may be reconditioned by lapping with an extra fine grinding compound. If a true seat cannot be obtained by lapping, a new plug and seat must be in-



CLOSED: HAND PUMP FLUID PRESSURE GOES DIRECTLY TO THE ACTUATING CYLINDERS.

WARNING

OPEN VALVE ONLY WHEN AIRPLANE IS ON GROUND. SAFETY WIRE VALVE IN "OFF" POSITION AT ALL TIMES DURING FLIGHT TO PERMIT HAND PUMP OPERATION TO DELIVER FLUID DIRECTLY TO ACTUATING CYLINDERS.

OPEN: HAND PUMP BUILDS UP THE FLUID PRESSURE IN THE PRESSURE ACCUMULATOR TANK.

Figure 383—Hand Pump to Pressure Accumulator Shut-Off Valve

(Douglas Dwg. No. 2130323)
(Made from Parker 252-1CT-8 or 252-1CT-8D Valve, or Lunkenheimer 557 Angle Valve)

TEST PROCEDURE

Test Port	*Ports Plugged*	*Test Pressure*	*Handle Position*	*Max Leakage*	*Flow*
A	B	1500 psi	Closed to Open	1 drop per 48 hrs past packing	———
A	None	100 psi	Closed	None	4 to 8 cu inches per minute

stalled. The new parts should be lapped to a true seat and all traces of the grinding compound removed by washing the parts in clear gasoline.

3. If the packing is worn or defective, new packing should be installed.

4. When repair of the valve has been completed, assemble and test for fluid leaks as specified in figure 383.

(11) DISCONNECT VALVES.

(a) DESCRIPTION.—Disconnect valves are installed in the hydraulic supply and pressure lines to the engine-driven pumps and are located in plate assemblies on the fire walls. The disconnect valves provide a means of disconnecting the hydraulic lines at the fire wall without the loss of fluid or the introduction of air into the lines when the engine section is

removed from the airplane. The disconnect valve (figure 384) consists of a spring-loaded steel ball that seats on the valve housing and a union fitting and gasket. When the hose assembly, which connects the engine-driven pump and disconnect valve, is connected and tightened on the disconnect valve, the ball in the valve is unseated by a pin in the hose assembly end. Therefore, the hydraulic fluid can flow through the disconnect valve. When the hose assembly is disconnected from the valve, the valve ball is seated by the spring and the fluid flow is checked. When the hose assemblies are disconnected and the engine section removed, it is not necessary to drain the hydraulic supply and pressure lines at the fire wall.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

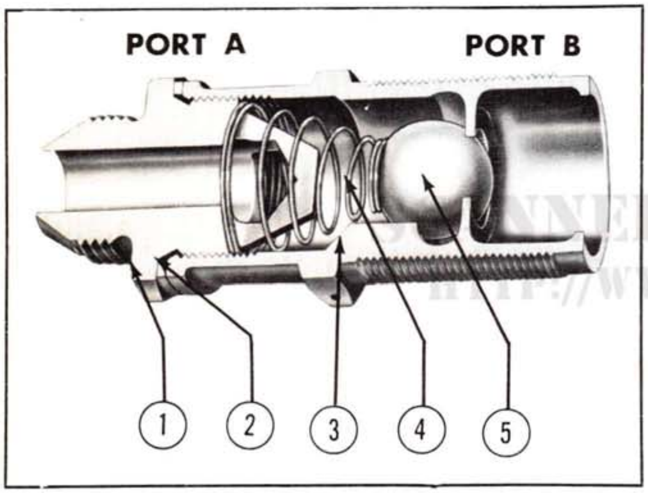


Figure 384—Typical Disconnect Valve

b. Disconnect and cap the hose assembly leading to the disconnect valve.

c. Unscrew the lock nut that clamps the disconnect valve to the plate assembly on the fire wall. Remove the washers and disconnect valve.

2. DISASSEMBLY.—To disassemble the disconnect valve (figure 384) unscrew the union fitting and remove the gasket, spring, and steel ball.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the disconnect valve is leaking or is damaged, it should be replaced with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.—Refer to figure 384 for fluid leak tests of the disconnect valve.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the disconnect valve refer to figure 384. Be sure all parts are clean before assembly. Use ample approved thread lubricant on all male threads.

2. INSTALLATION.—To install the disconnect valve reverse the removal procedure.

(f) MAJOR OVERHAUL.

1. Remove and disassemble the disconnect valve in accordance with preceding instructions.

2. Inspect all parts for wear and install new parts if necessary. Install a new gasket.

3. The ball and seat may be reconditioned by lapping to a new seat as instructed in paragraph 13.*b.*(12)*(f)* following.

4. Assemble and test the disconnect valve for fluid leaks as instructed in figure 384.

(12) CHECK VALVES. *(See figure 385.)*

(a) DESCRIPTION.—Check valves are installed in the hydraulic system lines to maintain the flow of fluid in one direction only, preventing a return flow

TEST PROCEDURE

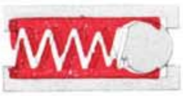
Test Port	*Ports Plugged*	*Test Pressure*	*Max Leakage*
A	None	5 psi	10 drops per hour
A	None	800 psi	10 drops per hour past ball. No other leakage

Item	*Part No.*	*Part Name*	*No. Req*
	2024790	Supply Line Disconnect Valve	2
1	1024789	Union	1
	AF995-C32-4	Lock Wire	1
2	AN900-20	Gasket	1
3	2007297	Body	1
4	1007293	Spring	1
5		13/16 Dia Steel Ball	1
	2024792	Pressure Line Disconnect Valve	2
1	1024791	Union	1
	AF995-C32-4	Lock Wire	1
2	AN900-16	Gasket	1
3	2007290	Body	1
4	1007286	Spring	1
5		9/16 Dia Steel Ball	1

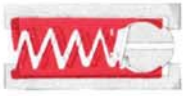
BALL TYPE

POPPET TYPE

SCHEMATIC VIEWS OF CHECK VALVES



CHECK VALVE

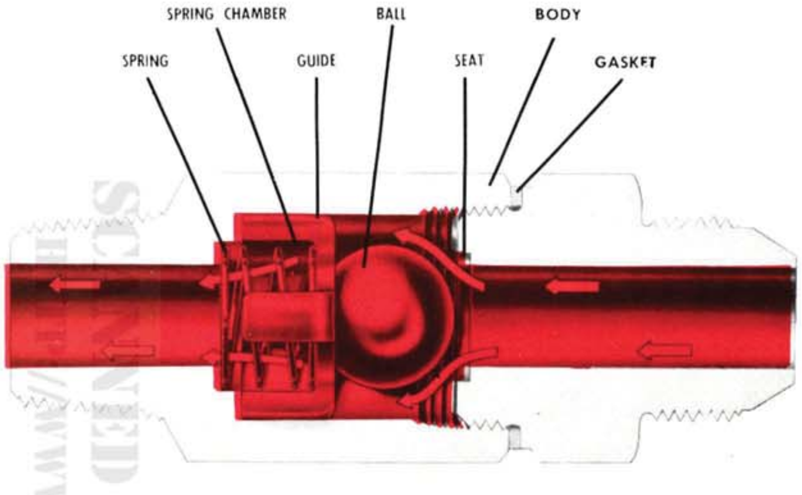


ORIFICE VALVE

An orifice check valve is a check valve with a hole in the poppet. Its purpose is to allow free flow of fluid in one direction, but only to restrict back flow instead of stopping it entirely. Time lag produced by the restriction depends on the size of the hole in the poppet.

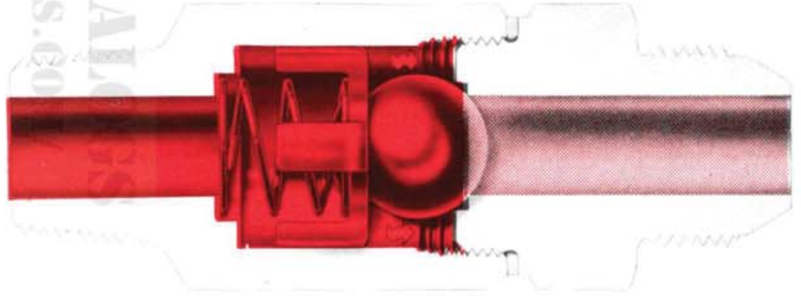
EXTERIOR VIEWS OF TYPICAL CHECK VALVES

TEST PROCEDURE			
TEST PORT	PORTS PLUGGED	TEST PRESSURE	MAXIMUM LEAKAGE
OUTLET	NONE	1500 psi.	NONE
OUTLET	NONE	5 psi.	1 DROP IN 2 MINUTES INTERNAL NONE EXTERNAL
OPENING PRESSURE AT INLET 2 TO 6 psi			



FLOW OF FLUID

Fluid pressure exerted on ball from inside seat forces ball from seat, moving guide back and compressing spring. When valve opens, fluid flows around ball and through spring chamber.



BACK FLOW PREVENTED

As fluid stops flowing, pressure on either side of ball is equalized for an instant before flow direction can change. Released spring forces guide to return ball to seat closing valve before fluid can back flow. If back flow pressure increases, valve is held closed by proportionately more force.

COLOR CODE:

▨ HYDRAULIC FLUID

🟥 HYDRAULIC FLUID PRESSURE

14,468

Figure 385—Typical Check Valve

of fluid through certain lines. The check valves have a similar construction, consisting of a housing with inlet and outlet openings and containing the valve ball or poppet, valve seat, and spring. The check valves in the airplane differ in size, shape, and end fittings. Various types of check valves have been used in the airplane; some incorporate steel ball checks, and some incorporate plastic or steel poppets. The operation of all these check valves is the same. Fluid entering the inlet port unseats the valve ball or poppet and fluid flow is permitted in one direction. The poppet is immediately seated by fluid pressure and spring pressure, when back flow of the fluid occurs, immediately preventing any further back flow.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system gage indicates "zero."

b. Disconnect and cap the lines or fittings leading to the check valve and remove the check valve.

2. DISASSEMBLY.—To disassemble the check valve unscrew the end fitting or plug and remove the ball or poppet and spring. (See figure 385.)

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Internal leakage of the check valve is caused by a defective ball or poppet or a worn valve seat, and the check valve must be replaced with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.—Refer to figure 385 for fluid leak tests of the check valve.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the valve, refer to figure 385. Be sure all parts are clean before assembly.

2. INSTALLATION.—To install the check valve, reverse the removal porcedure.

(f) MAJOR OVERHAUL.

1. Remove and disassemble the check valve. Inspect the valve ball for evidence of roughness or corrosion; replace the ball if these conditions are found.

2. Check the condition of the valve seat. If this part is slightly worn it can be reconditioned by carefully lapping with extra fine grinding compound. Proceed as follows:

a. Select a short length of steel tubing having an inside diameter slightly smaller than the valve ball. Force a new valve ball into the end of this tube so that slightly more than half the ball extends from the tube.

b. Using extra fine grinding compound, lap the ball to the seat with a combined tapping and rotary motion to avoid "ringing" the seat.

c. The seat should be carefully washed in clear gasoline after lapping to remove all traces of grinding compound.

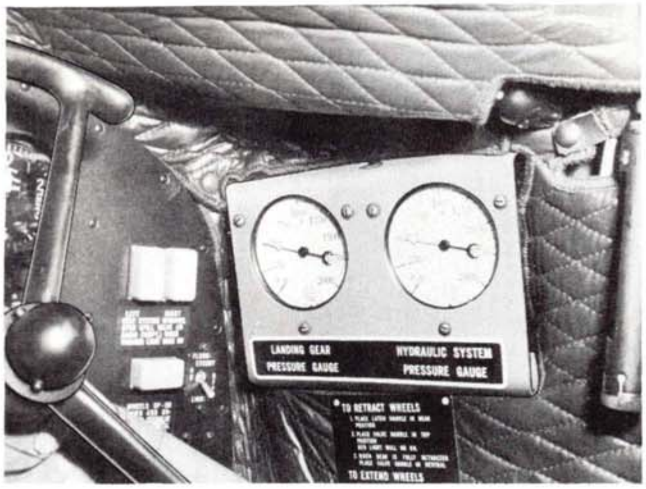


Figure 386—Hydraulic Fluid Pressure Gages Installed

d. Install a new valve ball because the ball used for lapping the valve seat must not be used in the check valve.

3. If the valve seat cannot be satisfactorily reconditioned by lapping, a new seat should be installed. Both the valve seat and the valve ball should be replaced at the same time, as a satisfactory seat cannot be obtained when a new seat is used with an old ball or when a new ball is installed without reconditioning the valve seat to a true surface.

4. The procedure for lapping a steel poppet is similar to that outlined for a steel ball.

5. It is not necessary to lap plastic poppets to seat; the plastic poppets are seated by hydraulic pressure when in use. Chipped or cracked plastic poppets must be replaced with new parts.

6. Damaged or fatigued springs should be replaced with new parts.

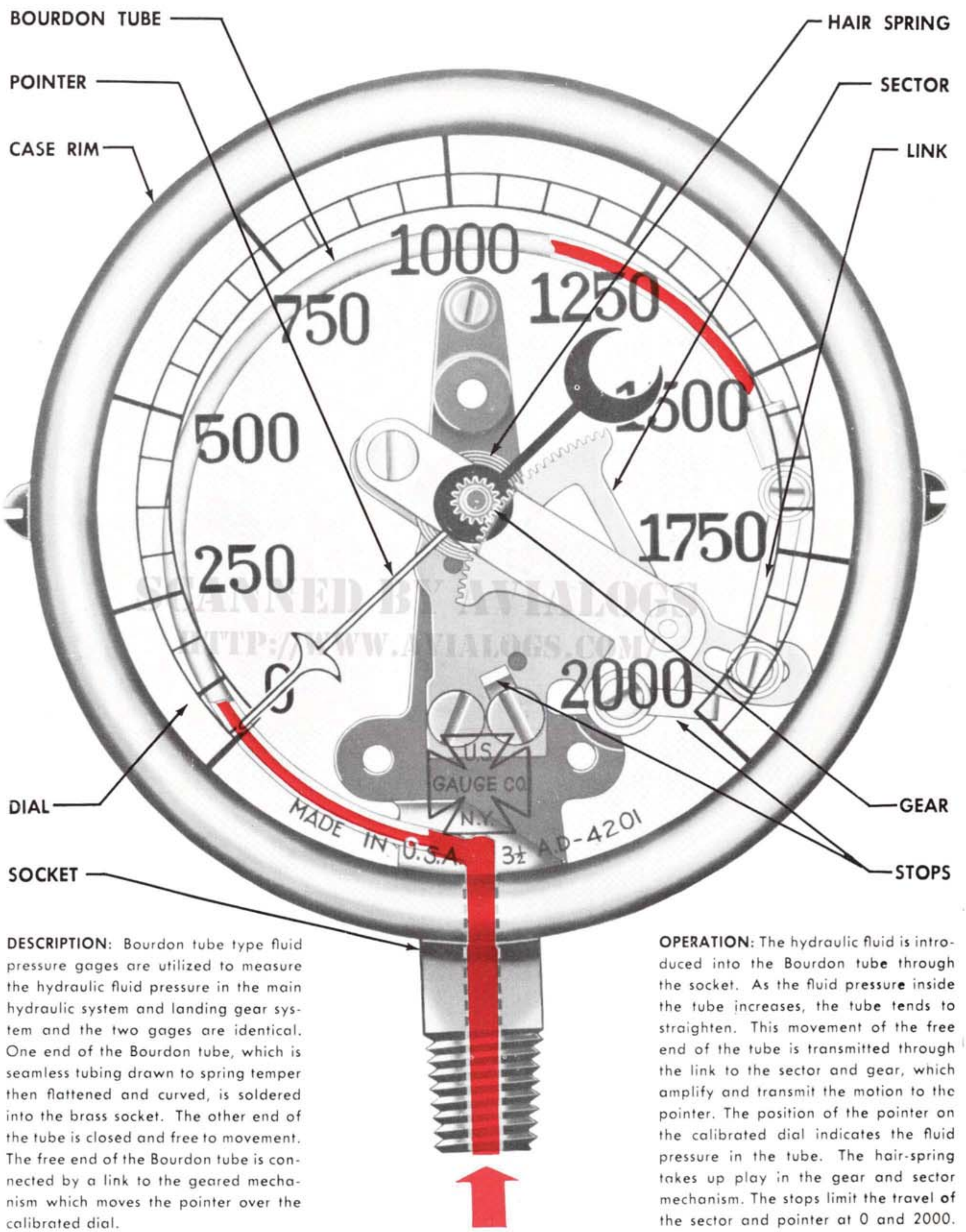
7. Inspect gaskets for deterioration and install new parts if necessary.

8. When repairs to the valve are complete, assemble and test for fluid leaks.

(13) HYDRAULIC PRESSURE GAGES.

(See figure 387.)

(a) DESCRIPTION.—Two hydraulic pressure gages are mounted in a bracket assembly on the right side of the pilots' compartment. One gage indicates the fluid pressure in the hydraulic system and the other indicates the fluid pressure in the landing gear DOWN line. (See figure 386.) The hydraulic pressure gages are identical and are of the Bourdon tube type. The hydraulic fluid under pressure flows into the brass socket of the gage and into the Bourdon tube, which is seamless tubing drawn to spring temper, then flattened and curved. One end of the tube is soldered into the socket while the other end is closed and free to move. The tube tends to straighten as the hydraulic pressure increases inside the tube. This movement of the free end


BOURDON TUBE
POINTER
CASE RIM
DIAL
SOCKET
HAIR SPRING
SECTOR
LINK
GEAR
STOPS
0
250
500
750
1000
1250
1500
1750
2000
U.S.
GAUGE CO.
N.Y.
MADE IN U.S.A.
3½
A.D-4201

DESCRIPTION: Bourdon tube type fluid pressure gages are utilized to measure the hydraulic fluid pressure in the main hydraulic system and landing gear system and the two gages are identical. One end of the Bourdon tube, which is seamless tubing drawn to spring temper then flattened and curved, is soldered into the brass socket. The other end of the tube is closed and free to movement. The free end of the Bourdon tube is connected by a link to the geared mechanism which moves the pointer over the calibrated dial.

OPERATION: The hydraulic fluid is introduced into the Bourdon tube through the socket. As the fluid pressure inside the tube increases, the tube tends to straighten. This movement of the free end of the tube is transmitted through the link to the sector and gear, which amplify and transmit the motion to the pointer. The position of the pointer on the calibrated dial indicates the fluid pressure in the tube. The hair-spring takes up play in the gear and sector mechanism. The stops limit the travel of the sector and pointer at 0 and 2000.

Figure 387—Operation of Hydraulic Fluid Pressure Gage (U. S. Gauge Co. No. 1212)

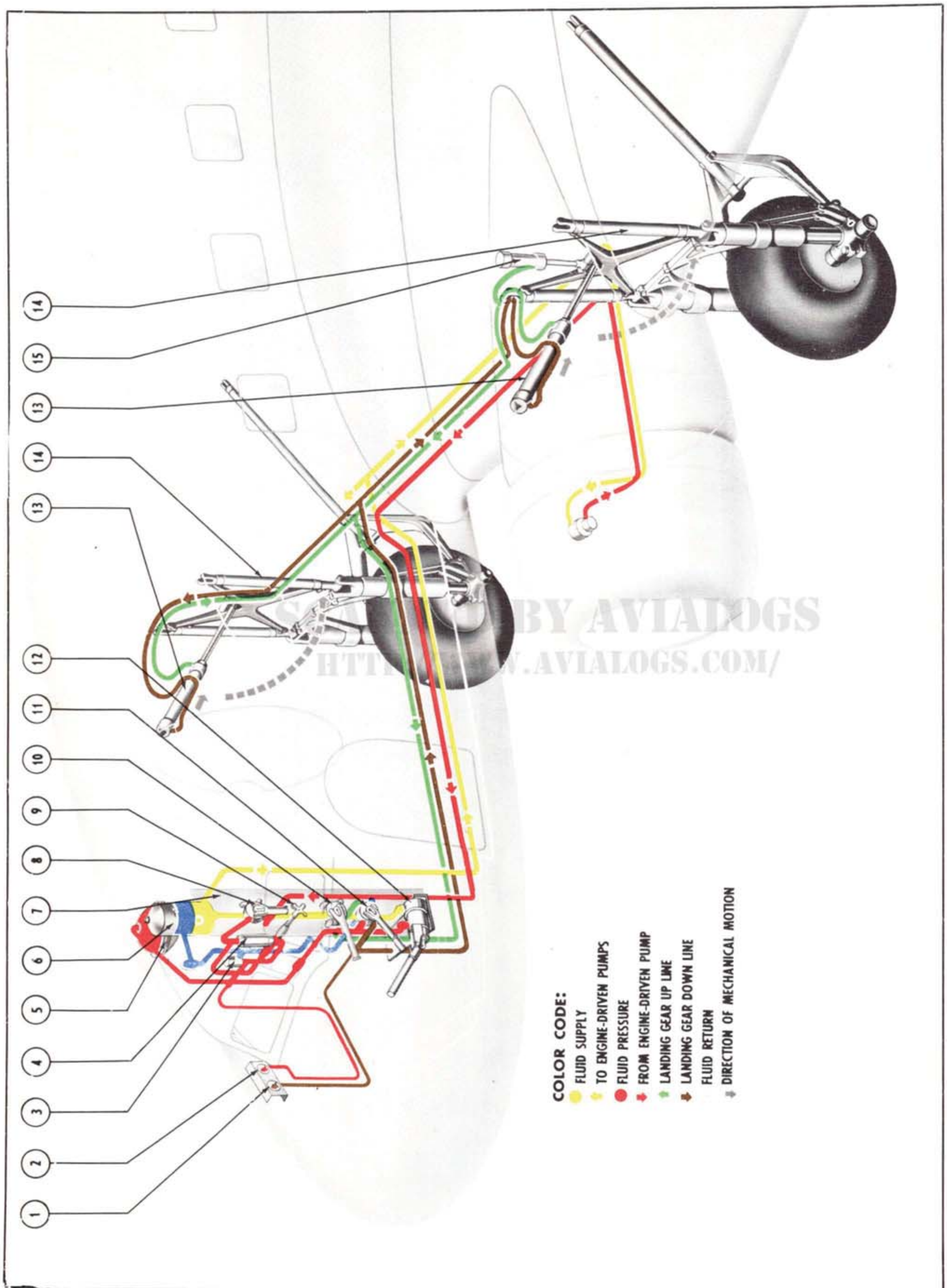

1
2
3
4
5
6
7
8
9
10
11
12
13
14
13
15
14
COLOR CODE:
● FLUID SUPPLY
↑ TO ENGINE-DRIVEN PUMPS
● FLUID PRESSURE
→ FROM ENGINE-DRIVEN PUMP
↑ LANDING GEAR UP LINE
↓ LANDING GEAR DOWN LINE
FLUID RETURN
↑ DIRECTION OF MECHANICAL MOTION

Figure 388—Landing-Gear Hydraulic System

KEY TO FIGURE 388

(Douglas Dwg. Nos. 5110513, 5141942, 5110553 and 5141943)

1. Landing-Gear Hydraulic Pressure Gage
2. Hydraulic System Pressure Gage
3. Hydraulic System Pressure Relief Valve (See figure 375)
4. Hydraulic System Pressure Regulator (See figure 368)
5. Hydraulic System Pressure Accumulator (See figure 367)
6. Hydraulic System Fluid Reservoir (See figure 374)
7. Hydraulic Control Panel (See figure 361)
8. Engine-Driven Hydraulic Pump Selector Valve (See figure 366)
9. Hand Pump to Pressure Accumulator Shut-Off Valve (See figure 383)
10. Wing Flap Control Valve (See figure 390)
11. Landing-Gear Control Valve (See figure 390)
12. Hydraulic Hand Pump (See figure 376)
13. Landing-Gear Actuating Cylinder (See figures 391 and 392)
14. Landing-Gear Upper Truss
15. Landing-Gear Hydraulic Compensator — Some Airplanes (See figure 398). Shown on Only One Landing-Gear Assembly

Note

For tubing and fittings information refer to figure 639, section VIII.

of the tube is transmitted through a link to the geared mechanism which amplifies and transfers the motion to the pointer. The position of the pointer on the calibrated dial indicates the hydraulic pressure to which the Bourdon tube is subjected. A hairspring takes up the backlash in the gage mechanism, while two stops are utilized to limit the gear sector movement and rotation of the pointer at 0 and 2000 psi.

(b) REMOVAL.

1. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

2. Disconnect and cap the hydraulic lines leading to the pressure gages.

3. Remove the screws that attach the bracket and gage assembly to the airplane.

4. Remove the screws attaching the pressure gages and collars to the bracket assembly. Remove the gages.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Except for cleaning of the hydraulic pressure gage dials, no attempt should be made to repair the gages. Only qualified instrument repair personnel at depots should disassemble or perform repairs to the gages. If the hydraulic pressure gages are damaged or are not functioning properly, new or serviceable gages should be installed.

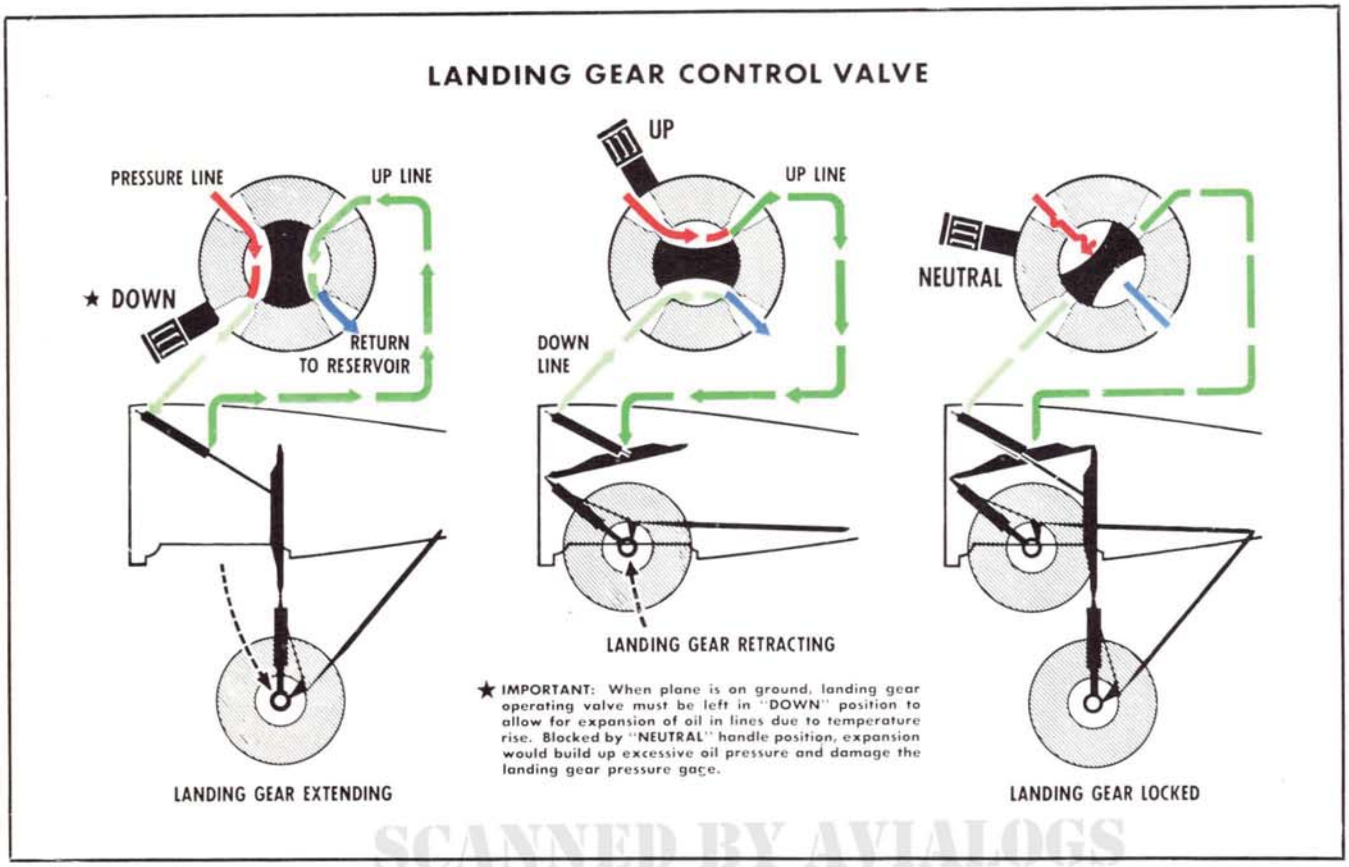
(d) INSTALLATION.—To install the hydraulic pressure gages, reverse the removal procedure.

c. LANDING GEAR HYDRAULIC SYSTEM.

(See figure 388.)

(1) GENERAL.—The main landing gear is extended and retracted by two hydraulic actuating cylinders, one located in each nacelle, and controlled by a four-way control valve (figure 361) located on the hydraulic control panel aft of the copilot's seat. When the control valve handle is moved up to the "UP" position (figure 389) after the release of the landing gear mechanical safety latch, the valve directs hydraulic fluid under pressure from the hydraulic system pressure manifold to the landing gear UP line. The fluid flows to the bottom of each landing gear actuating cylinder, forcing the pistons to retract. As the pistons retract, each main landing gear is pulled into the main landing gear wheel wells in the nacelles. As the landing gear is retracted the fluid in the upper portion of the landing gear actuating cylinders is forced into the landing gear DOWN lines and flows through the landing gear control valve to the hydraulic fluid reservoir. There are no mechanical locks to hold the landing gear in the "UP" position and only fluid pressure in the actuating cylinder holds the landing gear in the retracted position. Therefore, the landing gear control valve handle should be moved to the "NEUTRAL" position after the landing gear is retracted to lock the fluid pressure in the actuating cylinder. When the landing gear control valve handle is moved to the "DOWN" position (figure 389), fluid under pressure is directed to the top of the actuating cylinders and forces the cylinder piston rods to extend and, in turn, extend the main landing gear. Fluid in the lower portion of the actuating cylinders is forced into the landing gear UP lines, flows through the landing gear control valve, and returns to the hydraulic reservoir. To help balance the weight of the landing gear elastic shock cord, bungees are attached to fittings at the top of the landing gear on some airplanes. The bungees were replaced with hydraulic compensators on later airplanes to assist in retracting the landing gear. A hydraulic pressure gage (figure 386), mounted in a bracket beside the hydraulic system pressure gage on the right side of the pilots' compartment, indicates the fluid pressure in the landing gear DOWN lines. No provision is made for thermal expansion of the fluid in the landing gear hydraulic system. Therefore, when the airplane is on the ground, the landing gear control valve handle should remain in the "DOWN" position, which connects the landing gear hydraulic system to the pressure and return manifolds and excess fluid pressure in the landing gear DOWN line is relieved through the bleed hole in the hand pump to pressure accumulator shut-off valve.

(2) LANDING GEAR CONTROL VALVE.—The landing gear control valve is located on the hydraulic panel above the hydraulic hand pump, and controls the flow of hydraulic fluid to the landing gear actuating cylinders. Two makes of valves have been installed: the first is installed on all C-47, early C-47A and early C-47B airplanes; the second is installed on late C-47A and late C-47B airplanes. Both types of valves are constructed so that fluid pressure from the system pressure



★ IMPORTANT: When plane is on ground, landing gear operating valve must be left in "DOWN" position to allow for expansion of oil in lines due to temperature rise. Blocked by "NEUTRAL" handle position, expansion would build up excessive oil pressure and damage the landing gear pressure gage.

Figure 389—Operation of Landing Gear

manifold may be directed to either end of the landing gear actuating cylinders or the fluid flow to the actuating cylinders may be blocked entirely. When the control valve handle is in the "NEUTRAL" position, both ports to the actuating cylinders are closed and fluid flow either to or from the actuating cylinders is blocked. Note that in the later type valve, a slight internal leakage normally occurs as the handle is being moved between either of the two operating positions and the "OFF" position. This leakage did not occur in the earlier type valve. Note also, that in the later valve the operating handle should be moved quickly, in order to cut down the leakage to a minimum, while in the earlier valve the handle may be moved more slowly. This is the main difference in the operation of the two valves. The two valves are completely interchangeable. When the control handle is moved to the "UP" position, the pressure manifold is connected to the landing gear UP line and the return manifold is connected to the landing gear DOWN line. When the valve control is moved to the "DOWN" position, the pressure manifold is connected to the DOWN line and the return manifold is connected to the UP line. The control valve handle operates in a notched quadrant and it is necessary to lift the handle slightly to move it from one position to another. The landing gear mechanical latch is connected to the landing gear control valve by a rod, and the catch and shoe mechanism on the control valve is designed so that the landing gear mechanical latch control handle, located on the floor of the pilots' compartment must be raised to the "LATCH RAISED" position before the landing gear control valve handle may be moved to the "UP" position to retract the landing gear.

(a) LANDING GEAR CONTROL VALVE—EARLY AIRPLANES. *(See figure 390.)*

1. DESCRIPTION.—This valve is of the same basic design as the engine selector valve on early airplanes as described in this section, paragraph 13.*b.*(4) *(b),* with the following exceptions:

a. The quadrant permits locking the handle in a "NEUTRAL" position so that all ports are closed. A semi-circular relief notch is milled in the end of the face of the body to provide clearance for the handle locking mechanism.

b. The plug is constructed to allow two "OPEN" positions, and one "NEUTRAL" (locked) position. An unmilled surface is provided to block off fluid flow in the lines by closing the operating ports when the handle is stopped in the "NEUTRAL" position.

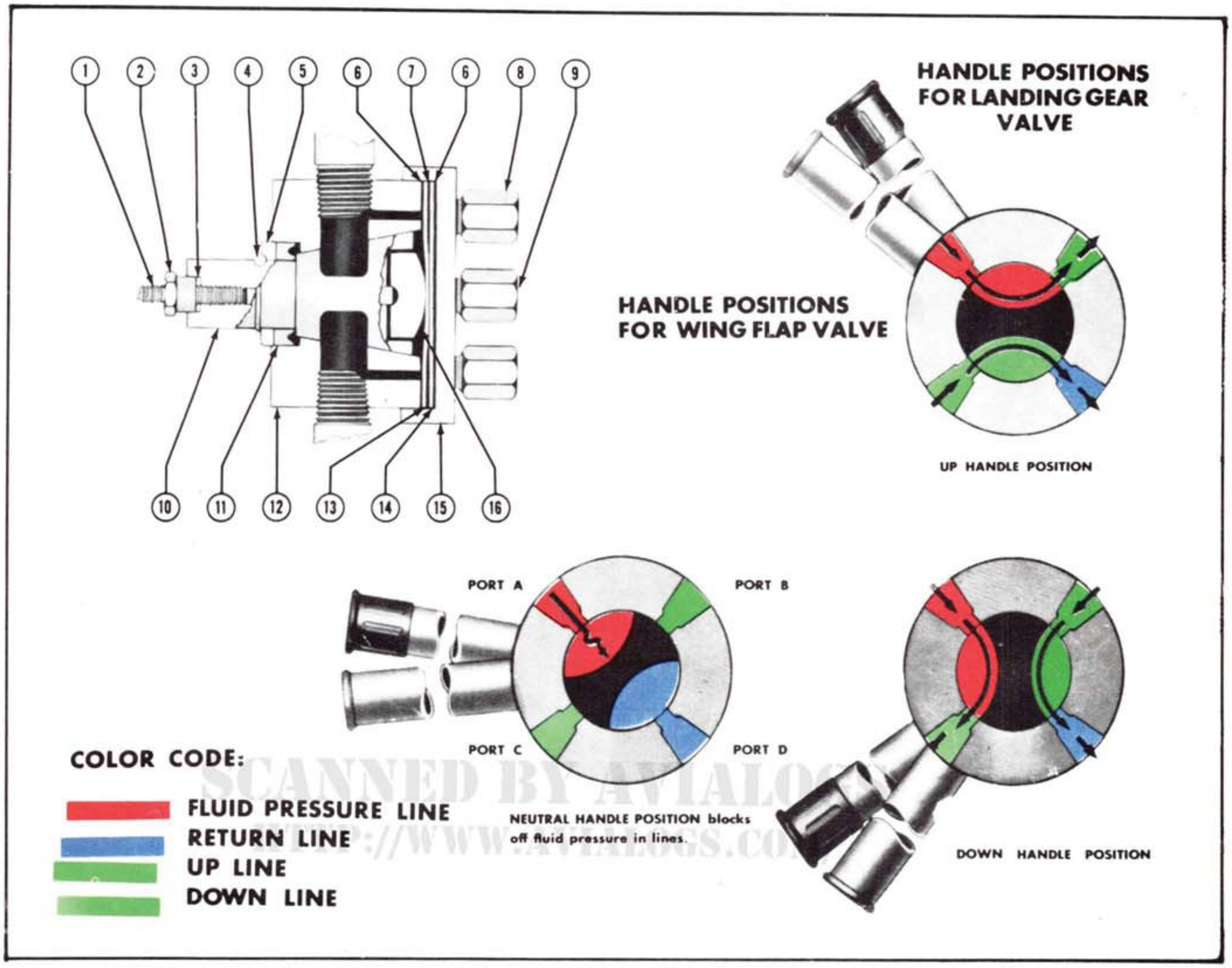

①
②
③
④
⑤
⑥
⑦
⑥
⑧
⑨
⑩
⑪
⑫
⑬
⑭
⑮
⑯
HANDLE POSITIONS FOR LANDING GEAR VALVE
HANDLE POSITIONS FOR WING FLAP VALVE
UP HANDLE POSITION
PORT A
PORT B
PORT C
PORT D
NEUTRAL HANDLE POSITION blocks off fluid pressure in lines.
DOWN HANDLE POSITION
COLOR CODE:
🟥 FLUID PRESSURE LINE
🟦 RETURN LINE
🟩 UP LINE
🟩 DOWN LINE

Figure 390—Landing-Gear and Wing Flap Control Valve Assembly—Early Airplanes

1. Screw
2. Nut
3. Washer
4. Lock Ring
5. Washer
6. Gasket
7. Gasket
8. Stud
9. Stud
10. Plug
11. Packing Cup
12. Body Assembly
13. Diaphragm
14. Diaphragm
15. Base
16. Bearing

KEY TO FIGURE 390

(Douglas Dwg. No. 4118984)

TEST PROCEDURE

NOTE: Before beginning the tests adjust the handle load to 14 ± 4 pounds at 9-5/8 inches (handle length) with 5 to 7 psi pressure at port A with ports B and C plugged.

Test Port	*Ports Plugged*	*Handle Position*	*Test Pressure*	*Max. Leakage*
A	B and C	Neutral to full both ways	1000 psi	1 drop in 48 hrs past packing cup. 10 drops per hr at "D."
D	B and C	Neutral to full both ways	125 psi	1 drop per hr at "A."
B	———	Neutral	2000 psi	10 drops per hr at "A." 10 drops per hr at "D."
C	———	Neutral	2000 psi	10 drops per hr at "A." 10 drops per hr at "D."

NOTE: After satisfactory completion of the tests set handle load to 3 ± 1 pounds at 9-5/8 inches (handle length) with 5 to 7 psi at port "A" with ports "B" and "C" plugged.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

(2) Disconnect and cap the four hydraulic lines leading to the landing gear control valve elbows.

(3) Remove the bolt, nut, and cotter which attach the rod to the landing gear safety latch catch assembly on the control valve. Remove the bolts that attach the valve to the panel and remove the landing gear control valve from the airplane.

(4) Remove the handle assembly and safety latch dog and shoe assembly from the valve before disassembly.

b. DISASSEMBLY.

To disassemble the landing gear control valve, refer to figure 390 and observe the following instructions.

(a) Unscrew the nut on the plug screw and remove the plug screw and washer.

(b) Remove the lock ring, washer, and packing cup from the plug.

(c) Unscrew studs from valve base. Remove the diaphragms, gaskets, bearing, and plug.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. External and internal fluid leakage of the valve may be remedied by tightening the plug screw. If tightening the plug screw will not stop the fluid leakage, replace the valve with a new part.

b. If the landing gear control valve is damaged or not functioning properly, replace it with a new or serviceable part.

4. ADJUSTMENTS.—For adjustments of the control valve with the landing gear mechanical safety latch system refer to this section, paragraph 4.*b.*(3)*(d)*.

5. TESTS BEFORE INSTALLATION.—Refer to figure 390 for fluid leak tests.

6. ASSEMBLY AND INSTALLATION.

a. ASSEMBLY.—To assemble the valve refer to figure 390 and observe the following instructions:

(1) If elbows have been removed from valve body, tin all male threads with soft solder, Federal Specification No. QQ-S-571, grade A (Navy 46-5-14, grade A). Screw elbows into valve tightly, but no more than is necessary or the valve body may be distorted.

(2) Check to see if the holes in the valve body are open to the valve ports. If the elbows cover the openings, drill a 3/32-inch hole to clear.

(3) After the elbows are in the correct position, lap the plug into the valve body with extra fine grinding compound. Clean the plug and valve body thoroughly with clear gasoline after lapping to remove all traces of the grinding compound. Lubricate the plug with hydraulic fluid, Specification No. AN-VV-O-366, and assemble in the valve body. The edge of the plug should not extend above the packing recess in the body more than 1/64 inch.

(4) Insert the bearing. The convex side of the bearing should not extend above the surface of the valve body more than .010 inch.

(5) Assemble gaskets and diaphragms in order shown in figure 390. Middle gasket must be installed with the slot between the two 5/16-inch studs.

(6) Assemble base on valve body and install studs, washers, and nuts. Set studs in white lead.

(7) Install the plug screw, washer, and nut. Insert the packing cup and washer; secure in place with the lock ring. The washer should extend into the valve body approximately 1/16 inch.

b. INSTALLATION.—To install the landing gear control valve, reverse the removal procedure as outlined in paragraph 13.*c.*(2)*(b)* preceding.

7. MAJOR OVERHAUL.

a. Remove and disassemble the landing gear control valve according to this paragraph 13.*c.*(2) *(b)* preceding.

b. Internal fluid leakage of the valve may be caused by a scored or worn valve plug. The plug may be reconditioned by lapping the plug into the valve body with extra fine grinding compound. Do not exceed the rework tolerances specified in figure 380. After lapping, wash the valve body and plug in clear gasoline to remove all traces of the grinding compound.

c. If lapping of the valve plug does not stop the internal leakage, the valve plug or valve body must be replaced with new parts. If new parts are installed, lap the plug into the valve body.

d. Refer to figure 380 for all rework tolerances.

e. Inspect all washers, packing cup, and diaphragms for wear, deterioration, or damage. Install new parts if necessary.

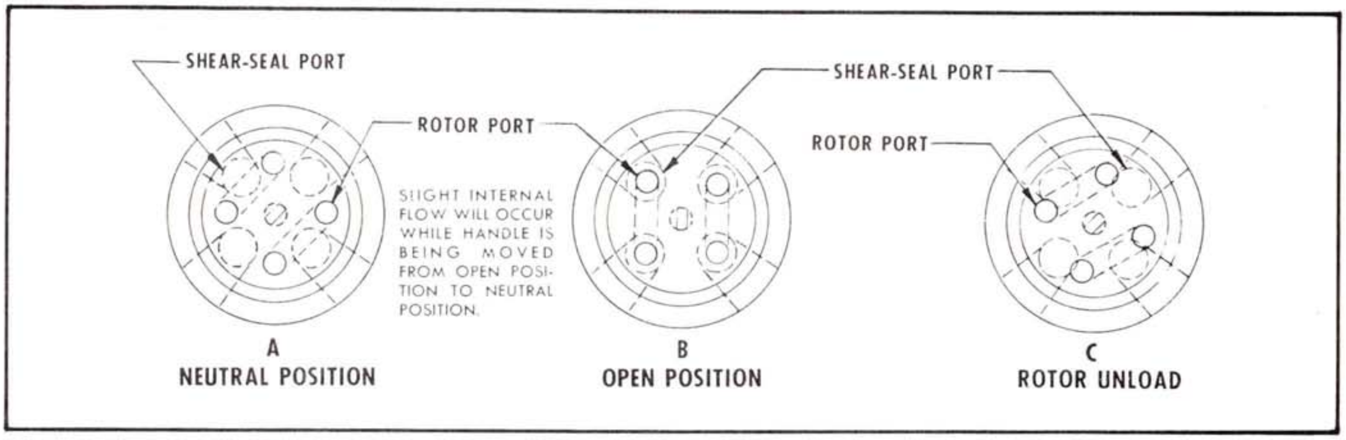
f. Assemble the valve and test for fluid leaks as instructed in figure 390.

(b) LANDING GEAR CONTROL VALVE—LATE AIRPLANES. *(See figure 390B.)*

1. DESCRIPTION.—This valve is of the same basic design as the hydraulic pump selector valve on late airplanes described in this section, paragraph 13.*b.* (4)*(c)*, with the following exceptions:

a. The quadrant permits locking the handle in a "NEUTRAL" position so that all ports are closed. A single semi-circular relief or notch is milled in the end face of the body to provide clearance for the handle locking mechanism.

b. The shaft is provided with a ¼-28NF-3 tapped hole instead of the ½ diameter lightening hole in the shaft of engine selector valve. This tapped hole



SLIGHT INTERNAL FLOW WILL OCCUR WHILE HANDLE IS BEING MOVED FROM OPEN POSITION TO NEUTRAL POSITION.

A
NEUTRAL POSITION

B
OPEN POSITION

C
ROTOR UNLOAD

Figure 390A—Landing Gear and Wing Flap Valve Rotor, Late Airplanes

TROUBLE SHOOTING FOR THE LANDING GEAR AND WING FLAP CONTROL VALVES LATE AIRPLANES

(Landing gear or wing flaps will not stay in position when valve handle is in neutral.)

Trouble	*Probable Cause*	*Remedy*
EXTERNAL LEAKAGE AT SHAFT.	Damaged shaft, AN-6227-13 "O" ring, shaft groove, or body bore	Inspect for damage, replace shaft or "O" ring AN-6227-13 as noted in this section, paragraph 13. *c.* (2) *(b)* 2. a. b. and c., below.
EXTERNAL LEAKAGE AT BASE.	Damaged AN-6227-27 "O" ring	See this section, paragraph 13. *c.* (2) *(b)* 2. a. b. and c., below.
INTERNAL LEAKAGE.	Damaged internal parts or "O" rings	See this section, paragraph 13. *c.* (2) *(b)* 2. a. b. and c., below.
INTERNAL LEAKAGE.	Dirt or lint under seat	Disassemble valve and clean with solvent and lint free cloth.

NOTE: In any case of apparent internal leakage, first check the valve handle to be sure a full throw of the handle has been accomplished. Improper "timing" of the valve may also be the cause.

is for attaching the special handle locking mechanism which is mounted when the valve is used as a landing gear control. Since this valve is used for both the landing gear and the wing flap control, the shaft with the tapped hole is also incorporated in the wing flap control, even though the tapped hole serves no purpose in the latter installation.

c. The porting plate in the landing gear control valve is not relieved on the sides as in the porting plate of the engine selector valve, since it is essential that this control has a "NEUTRAL" position (i.e. no flow in the mid-position). In all other respects the porting plates are identical.

Note

All parts of the hydraulic pump selector valve, and the valves for landing gear and wing flap controls are interchangeable, with the following exceptions: the quadrant, the shaft, the porting plate, and the body.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—To remove this valve, refer to the detailed removal instructions for removing the hydraulic pump selector control valve, as given in this section, paragraph 13.*b.*(4)*(c)*2.

b. DISASSEMBLY.—Refer to the detailed

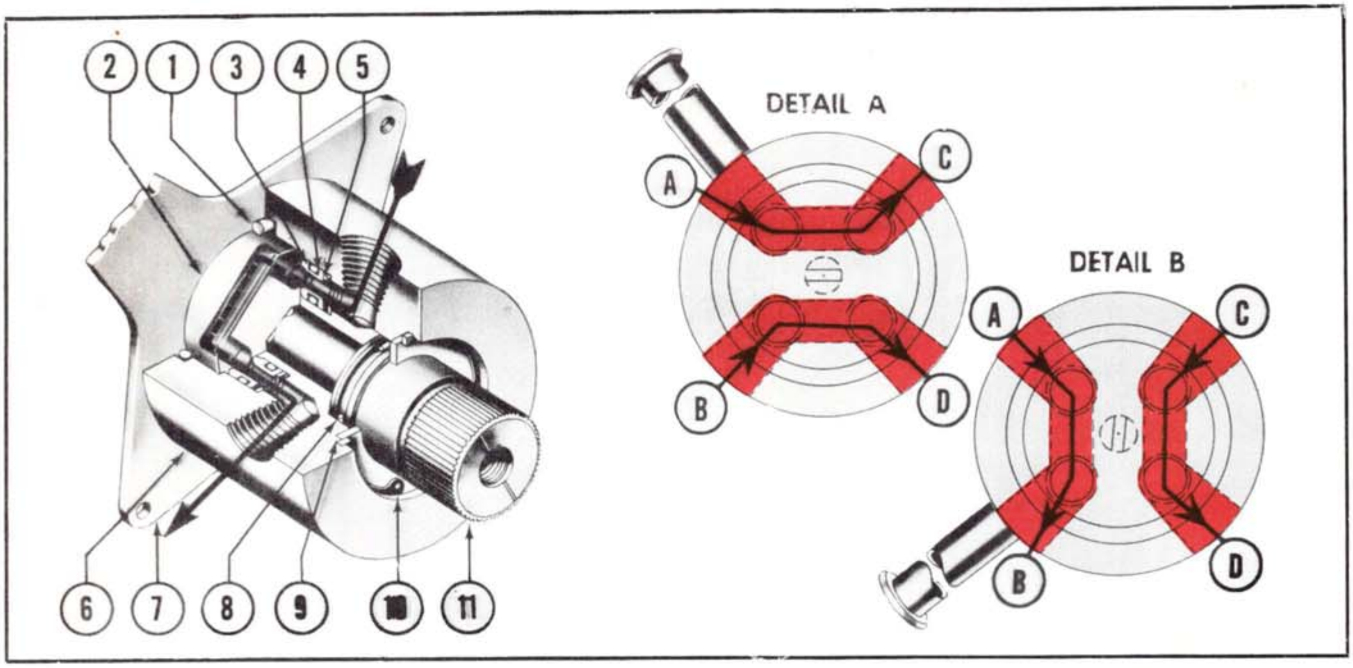


Figure 390B—Landing Gear and Wing Flap Valve Assembly—Late Airplanes

1. "O" Ring
2. Porting Plate
3. "O" Ring
4. Shear Seal
5. Spring
6. Body
7. Base
8. "O" Ring
9. Retainer
10. Snap Ring
11. Shaft

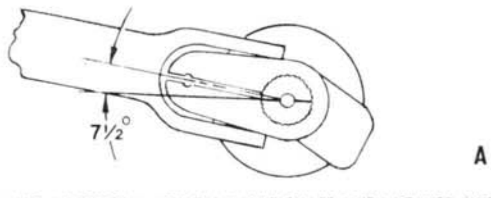
TEST PROCEDURE

To Test	*Apply Press. at*	*Plug Port*	*Applied Press.*	*Shaft Position*	*Max. Allowable Leakage*
Seals & Seats at A, B, & D	B	A & D	1000	As shown in Detail A or B	10 drops per hour at C
Seal & Seat at B	B	A & D	2000	Midway between Details A and B	10 drops per hour at C
Seals & Seats at A, C, & D	C	A & D	1000	As shown in Detail A or B	10 drops per hour at B
Seal & Seat at C	C	A & D	2000	Midway between position in Detail A and B	10 drops per hour at B
For external Leakage	C	A, B, & D	1000 & 5 to 7	20° ± 10° clockwise from position in Detail A & B	1 drop per 48 hour external

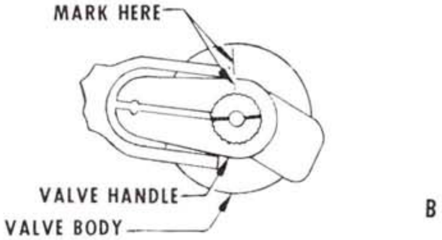
NOTES: Pressure drop from Port A to Port C and from Port B to Port D should not exceed 50 psi at a flow of 3 gallons per minute.

instructions for disassembly of the hydraulic pump selector control valve as given in this section, paragraph 13.*b*.(4)*(c)*2b. In addition, observe the following: Remove the mechanical safety latch dog and shoe assembly from the valve before disassembly.

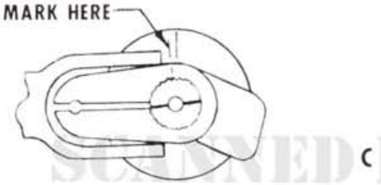
3. MAINTENANCE REPAIRS.—To clean and repair this valve refer to detailed instructions as given for the hydraulic pump selector valve in this section, paragraph 13.*b*.(4)*(c)3*.



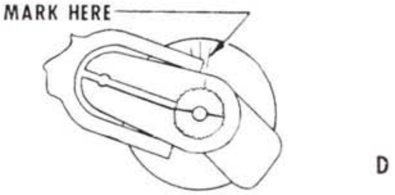
ALIGN SCRIBED MARK ON VALVE SHAFT WITH LOWER SIDE OF SLOT IN LANDING GEAR HANDLE. PLACE LANDING GEAR VALVE HANDLE IN NEUTRAL POSITION AND BUILD UP HYDRAULIC PRESSURE BY OPERATING HYDRAULIC HAND PUMP UNTIL IT IS DIFFICULT TO OPERATE (HAND PUMP SHUT-OFF IN CLOSED POSITION).



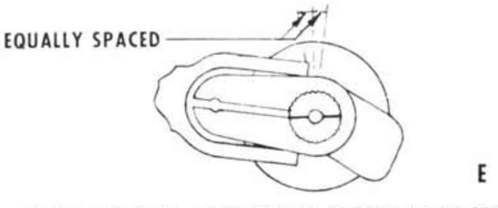
PLACE A PENCIL MARK 90° CLOCKWISE FROM SCRIBED MARK ON SHAFT VALVE HANDLE AND MAKE A CORRESPONDING MARK ON VALVE BODY.



MAINTAIN PRESSURE ON HAND PUMP HANDLE AND SLOWLY MOVE THE VALVE HANDLE TO DOWN POSITION UNTIL A SLIGHT MOVEMENT IS NOTED ON THE HYDRAULIC HAND PUMP HANDLE. THIS INDICATES THE START OF OPENING OF THE VALVE. PLACE A PENCIL MARK ON THE VALVE BODY TO CORRESPOND WITH THE PENCIL MARK ON THE VALVE HANDLE. RETURN VALVE HANDLE TO NEUTRAL POSITION AND BUILD UP HYDRAULIC PRESSURE BY OPERATING HYDRAULIC HAND PUMP UNTIL IT IS DIFFICULT TO OPERATE.



MAINTAIN PRESSURE ON HAND PUMP HANDLE AND SLOWLY MOVE THE VALVE HANDLE TO UP POSITION UNTIL A SLIGHT MOVEMENT IS NOTED ON THE HYDRAULIC HAND PUMP HANDLE. THIS INDICATES THE START OF OPENING OF THE VALVE. PLACE A PENCIL MARK ON THE VALVE BODY TO CORRESPOND WITH PENCIL MARK ON VALVE HANDLE.



PENCIL MARKS ON BODY SHOULD BE EQUALLY SPACED. UNEQUAL SPACING INDICATES IMPROPER TIMING OF VALVE OPENING AND HANDLE SHOULD BE RELOCATED ON SERRATIONS TO CORRECT TIMING OF VALVE OPENING.

Figure 390C—Timing Landing Gear Control Valve, Late Airplanes

CAUTION

In the landing gear control valve and the wing flap control valve, the porting plate must have a smooth plane surface. The minimum allowable thickness of the porting plate, after lapping to remove scratches, is .4990″. The thickness of this porting plate is critical, since a close clearance is required between it and the body in order to prevent excessive interflow while moving from one position to another. The thickness of the porting plate in the hydraulic pump selector valve is not critical.

4. ASSEMBLY.—To assemble this valve, refer to the detailed instructions for the hydraulic pump selector valve as given in this section, paragraph 13.*b.*(4)*(c)4.* In addition, assemble and install the dog and shoe.

5. ADJUSTMENTS.

a. Timing of the landing gear control valve is accomplished as described in figure 390A. These instructions must be followed carefully, as even a slight deviation may cause imperfect timing.

b. The design of the valve incorporates spring loading of the shear-seals in static condition, and hydraulic loading of the shear-seals in operation; handle load adjustment is, therefore, dispensed with.

CAUTION

It is urgently important that the handle of this valve be moved its entire travel in operation. Stopping even slightly short of full "NEUTRAL" or full "OPEN" position allows unloading of the valve through the body.

6. TESTS BEFORE INSTALLATION.—Test for leakage by applying pressure, from a hand or motor operated hydraulic pump, as outlined in tabulation under figure 390B.

Note

Use hydraulic fluid, Specification MIL-O-5606. Bleed all air out of unit prior to test.

7. INSTALLATION. — Attach the landing gear control valve to the hydraulic control panel, using AN3-6A bolts, AN935-10 lock washers in the three upper holes and AN3-13A bolt, AN935-10 lock washer, S138275-6-24 spacer, S138275-6-16 spacer in the lower hole.

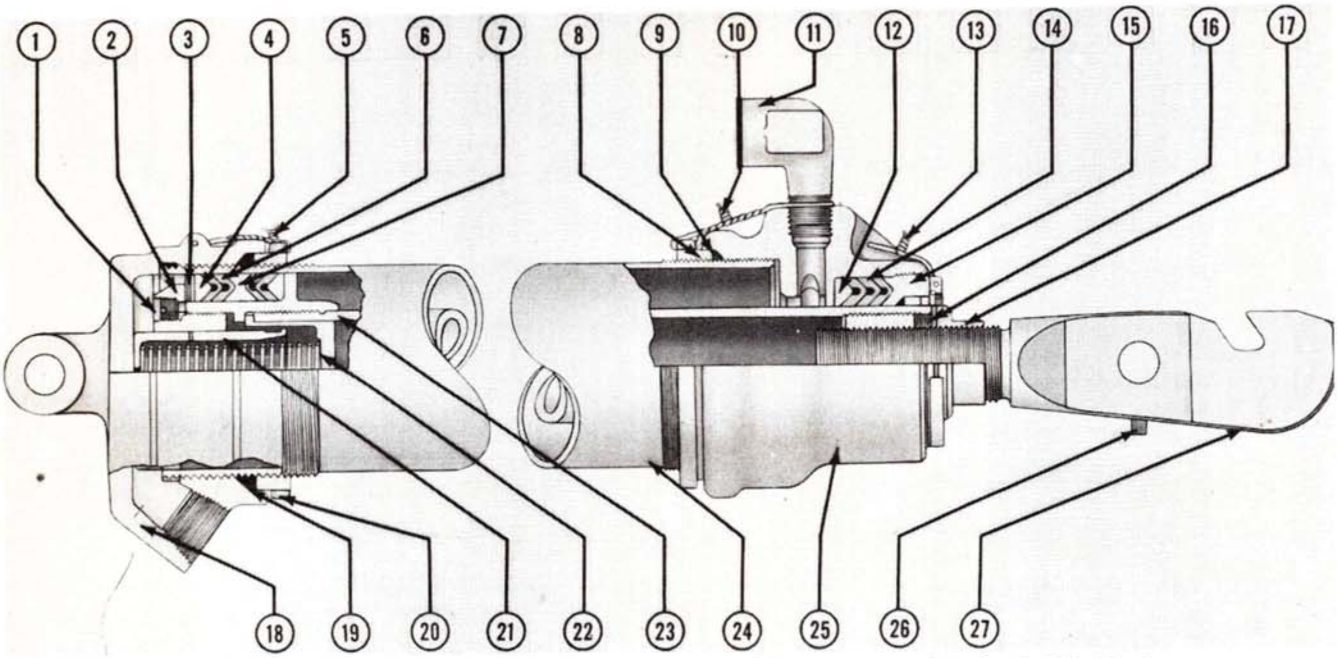

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

Figure 391—Landing-Gear Actuating Cylinder Assembly—C-47A and Early C-47B Airplanes

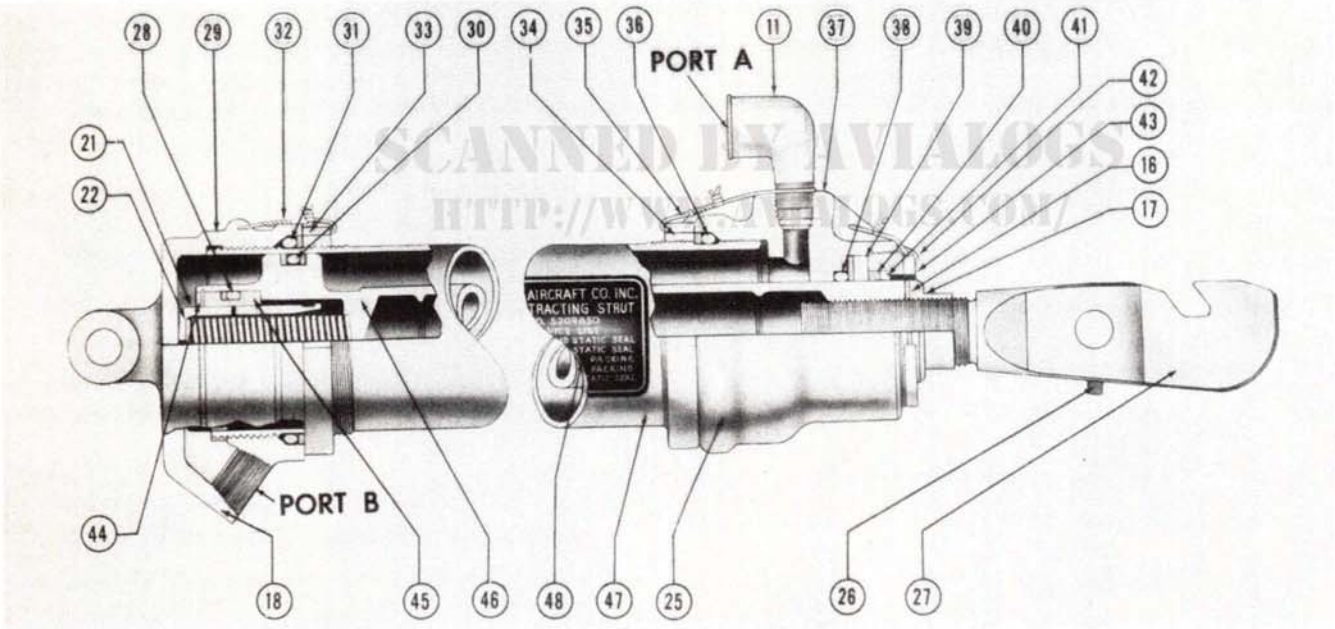

28
29
32
31
33
30
34
35
36
11
37
38
39
40
41
PORT A
42
43
16
17
21
22
AIRCRAFT CO. INC.
TRACTING STRUT
44
PORT B
18
45
46
48
47
25
26
27

Figure 391A—Landing-Gear Actuating Cylinder Assembly—Late C-47B Airplanes

TEST PROCEDURE

Test Port	*Piston Position*	*Test Pressure*	*Max. Leakage*
A	Retracted	2500 psi	2 drops in 12 hours external 10 drops per hour internal
B	Extended	2500 psi	2 drops in 12 hours external 10 drops per hour internal

Dash Pot Time—5 seconds minimum—18 seconds maximum.

KEY TO FIGURES 391 and 391A

Item	*Part No.*	*Part Name*	*No. Req*
1	1116920	Screw	1
2	1116919	Nut	1
3	143908-126D-214-032	Washer*	2
	143908-126D-214-064	Washer* (*Use as Required)	3

KEY TO FIGURES 391 and 391A—Continued

Item	*Part No.*	*Part Name*	*No. Req*
4	1012954-D-126-012	Spacer	2
5	AF995-41-4	Lockwire	1
6	5135865-6X-126	Packing	4
7	1116917	Spacer	1
8	1116924	Nut	1
9	143908-224-SR300-093	Washer	3
10	995-41-8	Lock Wire	1
11	AN914-3	Street Steel Elbow	1
12	1012954-D-116-012	Spacer	1
13	AF995-41-4	Lock Wire	1
14	513865-6X-116	Packing	3
15	2116929	Nut Assembly	1
	Consists of:		
	1117003	Nut	1
	1116916	Wiper	1
	1116915	Ring	1
	1116747	Lock Ring	1
16	1113433	Washer	1
17	1112830	Nut	1
18	4140756	Head	1
19	143908-224-SR300-093	Washer	3
20	1116924	Nut	1
21	1116921	Dash Pot	1
22	1116922	Spring	1
23	2113397	Piston Assembly	1
	Consists of:		
	2116928	Head	1
	1117621	Plug	1
	1117002	Rod	1
	1112831	Sleeve	1
24	4140786	Cylinder	1
		NOTE: Items 7, 19, 21, 22, and 24 Make Up 5116910 Cylinder Assembly	
25	4116930	Housing	1
26	A-5523	Lincoln Lubricator	1
27	4112833 or 4203951	Bolt	1
28	AN6227-22	"O" Ring	1
29	4140756	Head	1
30	AN6227-33	"O" Ring	1
	*AN6227A-33	"O" Ring	1
31	AN6227-37	"O" Ring	1
	*AN6227A-37	"O" Ring	1
32	AAF995-41-4	Lockwire	1
33	1209828	Nut	1
34	1209828	Nut	2
35	AAF995-41-8	Lockwire	1
36	AN6227-37	"O" Ring	2
37	4209980	Housing	1
38	AN6227-27	"O" Ring	1
	*AN6227A-27	"O" Ring	1
39	1209857	Retainer	1
40	AN6232-1	(Stock Length-6) Wiper	1
41	AN6231-17	Wiper	1
42	AAF995-41-4	Lockwire	1
43	1209848	Nut	1
44	NAS50-143	Retainer Ring	1
45	1189579	Bearing	1
46	4209826	Piston Assem	1
47	4209825	Cylinder	1
48	1189539	Decal	1

*On very late C-47B Airplanes only

Rework Tolerances Late Airplanes

A. If diametral clearance between dashpot and gland exceeds .002, rework to .001 to .002 by chrome plating dashpot or replacing parts. Dashpot may be chrome plated .010 on a diameter.

B. If diametral clearance between piston head and cylinder exceeds .006, rework to .001 to .006 by replacing chrome plating piston head or replacing piston and rod assembly.

C. Manufacturing dimension of piston head 2.499 to 2.497.

D. Manufacturing dimension of cylinder 2.500 to 2.503.

E. If diametral clearance between housing and rod exceeds .006 rework to .002 to .006 by chrome plating rod or replacing housing or piston and rod assembly.

Note

The piston rod may be ground to a minimum of .020 undersize. Piston rod may be chrome plated a maximum of .020 on a diameter. The cylinder may be honed a maximum of .020 oversize.

RAISED" position before the landing gear control valve handle can be moved to the "UP" position to retract the landing gear. For a complete description of the landing gear mechanical latch system refer to paragraph 4.*b*.(3), this section.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

b. Disconnect and cap the four hydraulic lines leading to the landing gear control valve elbows.

c. Remove the bolt, nut, and cotter which attach the rod to the landing gear safety latch catch assembly on the control valve. Remove the bolts that attach the valve to the panel and remove the landing gear control valve from the airplane.

d. Remove the handle assembly and safety latch dog and shoe assembly from the valve before disassembly.

2. DISASSEMBLY.

a. To disassemble the landing gear control valve, refer to figure 390 and observe the following instructions.

(1) Unscrew the nut on the plug screw and remove the plug screw and washer.

(2) Remove the lock ring, washer, and packing cup from the plug.

(3) Unscrew studs from valve base. Remove the diaphragms, gaskets, bearing, and plug.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. External and internal fluid leakage of the valve may be remedied by tightening the plug screw. If tightening the plug screw will not stop the fluid leakage, replace the valve with a new part.

2. If the landing gear control valve is damaged or not functioning properly, replace it with a new or serviceable part.

(d) ADJUSTMENTS.—For adjustments of the control valve with the landing gear mechanical safety latch system refer to this section, paragraph 4.*b*.(3)*(d)*.

(e) TESTS BEFORE INSTALLATION.—Refer to figure 390 for fluid leak tests.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the valve refer to figure 390 and observe the following instructions:

a. If elbows have been removed from valve body, tin all male threads with soft solder, Federal Specification No. QQ-S-571, grade A (Navy 46-5-14, grade A). Screw elbows into valve tightly, but no more than needed or valve body may be distorted.

b. Check to see if the holes in the valve body are open to the valve ports. If the elbows cover the openings, drill a 3/32-inch hole to clear.

c. After the elbows are in the correct position, lap the plug into the valve body with extra fine grinding compound. Clean the plug and valve body thoroughly with clear gasoline after lapping to remove all traces of the grinding compound. Lubricate **the plug with hydraulic fluid, Specification No. MIL-O-5606, and assemble in the valve body. The edge of the plug should not extend above the packing recess in the body more than 1/64 inch.**

d. Insert the bearing. The convex side of the bearing should not extend above the surface of the valve body more than .010 inch.

e. Assemble gaskets and diaphragms in order shown in figure 390. Middle gasket must be installed with the slot between the two 5/16-inch studs.

f. Assemble base on valve body and install studs, washers, and nuts. Set studs in white lead.

g. Install the plug screw, washer, and nut. Insert the packing cup and washer; secure in place with the lock ring. The washer should extend into the valve body approximately 1/16 inch.

2. INSTALLATION.—To install the landing gear control valve, reverse the removal procedure as outlined in paragraph 13.*c*.(2)*(b)* preceding.

g. MAJOR OVERHAUL.

(1) Remove and disassemble the landing gear control valve according to this paragraph 13.*c*.(2)*(b)* preceding.

(2) Internal fluid leakage of the valve may be caused by a scored or worn valve plug. The plug may be reconditioned by lapping the plug into the valve body with extra fine grinding compound. Do not exceed the rework tolerances specified in figure 380. After lapping, wash the valve body and plug in clear gasoline to remove all traces of the grinding compound.

(3) If lapping of the valve plug does not stop the internal leakage, the valve plug or valve body must be replaced with new parts. If new parts are installed, lap the plug into the valve body.

(4) Refer to figure 380 for all rework tolerances.

(5) Inspect all washers, packing cup, and diaphragms for wear, deterioration, or damage. Install new parts if necessary.

(6) Assemble the valve and test for fluid leaks as instructed in figure 390.

(3) LANDING GEAR ACTUATING CYLINDER. *(See figures 391, 391A, and 392.)*

(a) DESCRIPTION.—The landing gear actuating cylinder is attached to the nacelle structure aft of

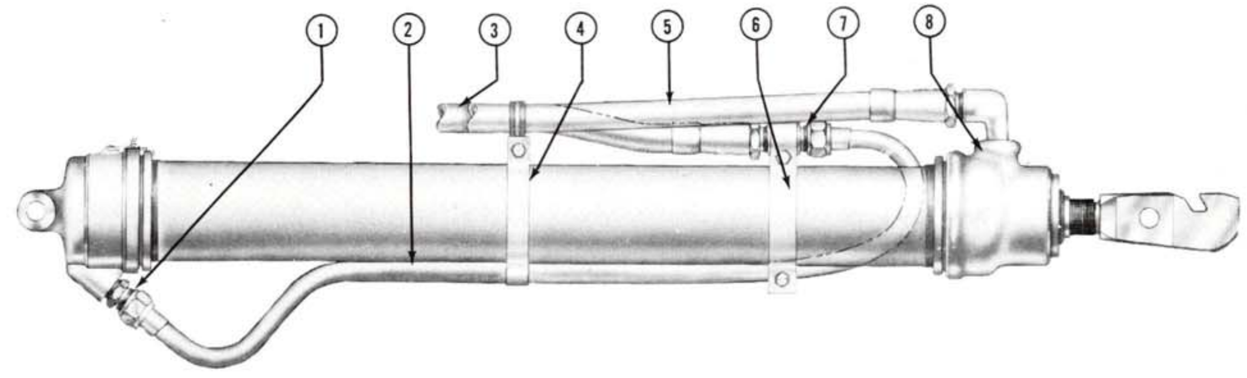


Figure 392—Landing-Gear Actuating Cylinder and Line Assembly

(Douglas Dwg. No. 5140045)

Item	*Part No.*	*Part Name*	*No. Req*
1	8FT-S	Parker Nipple	1
2	2139370-1 or 2139370-2	Line Assembly	1
3	2118392-2	Hose Assembly (Landing-Gear Down)	1
4	1139372	Clamp	1
	AN520-10-10	Screw	1
	AF365-1032	Nut	1
5	2118392-1	Hose Assembly (Landing-Gear Up)	1
6	2139369	Clamp Assembly	1
	AN3-6A	Bolt	1
	AF365-1032	Nut	1
7	1139371	Connector	1
8	5110586	Landing-Gear Actuating Cylinder Assembly (See figure 391)	1

NOTE: Refer to section VIII for lines fabrication information.

the fire wall, extends through an indentation in the oil tank, and the piston rod is bolted to the upper truss of the landing gear. (See figure 388.) When hydraulic fluid under pressure is directed to the upper end of the actuating cylinder, the piston rod extends and forces the landing gear to extend. When hydraulic fluid under pressure is directed to the lower end of the actuating cylinder, the piston rod retracts, pulling the landing gear up into the nacelle. The actuating cylinder mechanism includes a dashpot which serves as a shock absorber so that the actuating cylinder piston may come to rest slowly at the end of the retracting stroke without damage to the attaching structure. The dashpot traps some of the hydraulic fluid at the end of the piston's retracting stroke and the fluid is forced through a hole in the dashpot which absorbs energy and converts it into heat in the same manner as a shock absorbing strut.

(*b*) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Install ground safety pins in both landing gear upper trusses as shown in figures 130 and 131. The landing gear safety pins are stowed on the aft wall of the cargo compartment.

b. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

c. Disconnect the flexible hoses leading to the actuating cylinder at the connections located at the top of the nacelle. Cap the exposed ends of the flexible hoses and the connectors at the top of the nacelle.

d. The actuating cylinder must be supported from inside the nacelle while the bolt that attaches the actuating cylinder to the nacelle structure is removed. This bolt can be reached through access doors in the top of the nacelle aft of the fire wall.

e. Remove the bolt that attaches the actuating cylinder piston rod hook to the landing gear upper truss.

f. Move the landing gear mechanical safety latch control handle to the "LATCH RAISED" position as instructed in this section, paragraph 4.*b*.(3), and remove the landing gear actuating cylinder assembly (figure 392) from the airplane.

2. DISASSEMBLY.—Do not attempt disassembly of the landing gear actuating cylinder in the field. When disassembly is attempted, refer to figures 391 and 391A and observe the following procedure:

a. C-47A AND EARLY C-47B AIRPLANES

(1) Remove the lock wire and remove the piston rod hook end. Remove the snap ring, retaining ring, and felt wiper. Remove the hose and line assemblies.

(2) Remove the packing nut, packing, and spacer.

(3) Use a suitable clamp to hold the cylinder barrel when the barrel is clamped in a vise. The clamp should be in the form of two pieces of rubber-lined hardwood which extend the complete length of the cylinder barrel and encircle the barrel to insure that the clamping pressure is distributed evenly over the entire outside surface of the cylinder barrel. Place the clamp in a vise and tighten until the cylinder barrel is held securely.

(4) Remove the cylinder heads after backing off the packing nuts. Use service tool No. K21101 (figure 394), which may be fabricated according to figure 92.

(5) Remove the piston and piston rod assembly. Use service tool No. K22101 (figure 395) to remove the dashpot. This wrench may be fabricated according to figure 93.

(6) Loosen the set screw in the piston and back off the packing nut. Remove the washers, spacers, and packing.

b. LATE C-47B AIRPLANES.

(1) Remove the lock wire and remove the piston rod hook end. Remove the hose and line assemblies.

(2) Remove the retaining nut, wipers, retaining ring, and packing.

(3) Use a suitable clamp to hold the cylinder barrel when the barrel is clamped in a vise. The clamp should be in the form of two pieces of rubber-lined hardwood which extend the complete length of the cylinder barrel and encircle the barrel to insure that the clamping pressure is distributed evenly over the entire outside surface of the cylinder barrel. Place the clamp in a vise and tighten until the cylinder barrel is held securely.

(4) Remove the cylinder heads after backing off the lock nuts. Use service tool No. K21101 (figure 394), which may be fabricated according to figure 92.

(5) Remove the piston and piston rod assembly.

(6) Remove the dash pot snap ring, dash pot gland, dash pot, and spring.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. No maintenance is required of the landing

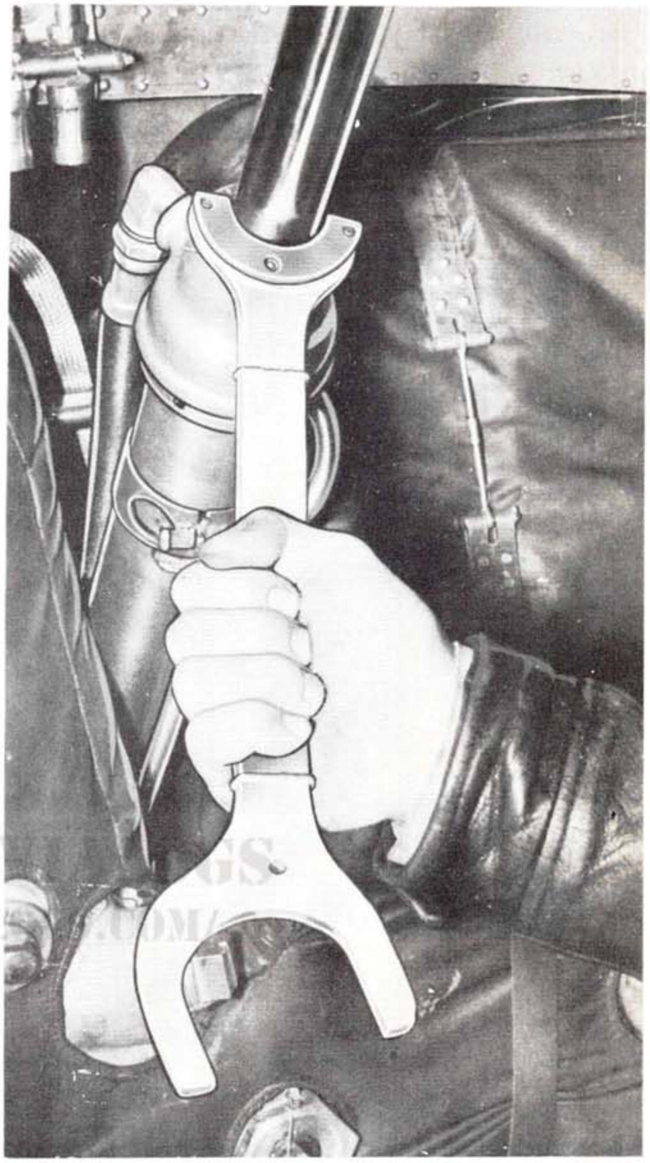


Figure 393—Use of Landing-Gear Actuating Cylinder Piston Rod Packing Nut Wrench (Service Tool No. K20001)

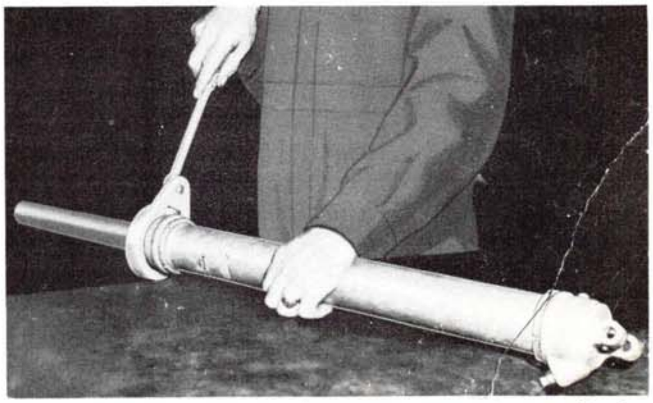


Figure 394—Use of Landing-Gear Actuating Cylinder Housing Wrench (Service Tool No. K21101)

gear actuating cylinders other than prevention of leakage. On early airplanes this is done by occasionally tightening the packing nuts, however, on later airplanes replacing of "O" rings will eliminate leakage.

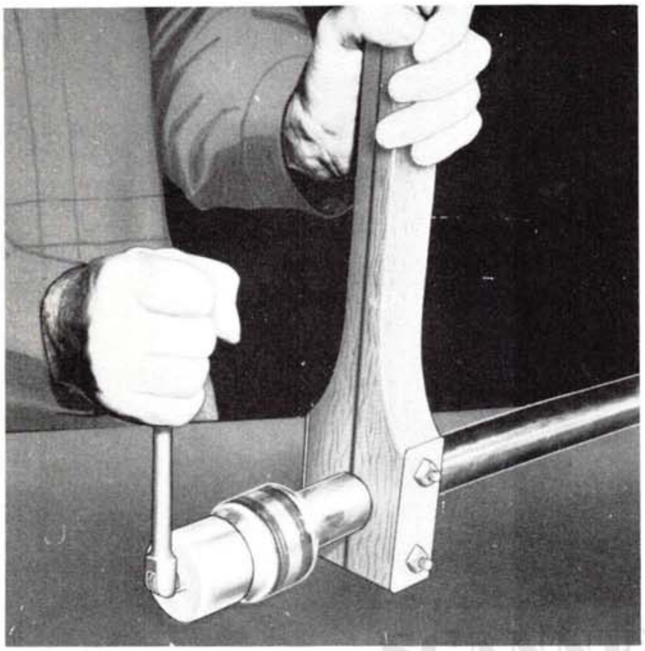


Figure 395—Use of Landing-Gear Actuating Cylinder Dashpot Wrench (Service Tool No. 22101)

2. On early airplanes only, the piston rod packing may be tightened while the actuating cylinder is installed on the airplane with service tool No. K20001 (figure 393). To fabricate this tool refer to figure 91.

3. If the landing gear actuating cylinder is damaged or is not functioning properly, a new or serviceable actuating cylinder should be installed.

(d) ADJUSTMENTS.—To adjust the landing gear actuating cylinder with the landing gear mechanism, refer to this section, paragraph 4.*b.*(3)*(d).*

(e) TESTS BEFORE INSTALLATION.—Refer to instructions under figures 391 and 391A for fluid leak tests of the landing gear actuating cylinder.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY. — To assemble the landing gear actuating cylinder, reverse the disassembly procedure as outlined in paragraph 13.*c.*(3)*(b)* preceding; refer to figure 391 and observe the following precautions:

a. Thoroughly remove all oil and grease and wipe all parts clean using lintless rags before assembling the actuating cylinder.

b. Tin all male pipe threads lightly with soft solder in accordance with Federal Specification No. QQ-S-571, grade A and Navy Specification No. 46-S-14, grade A.

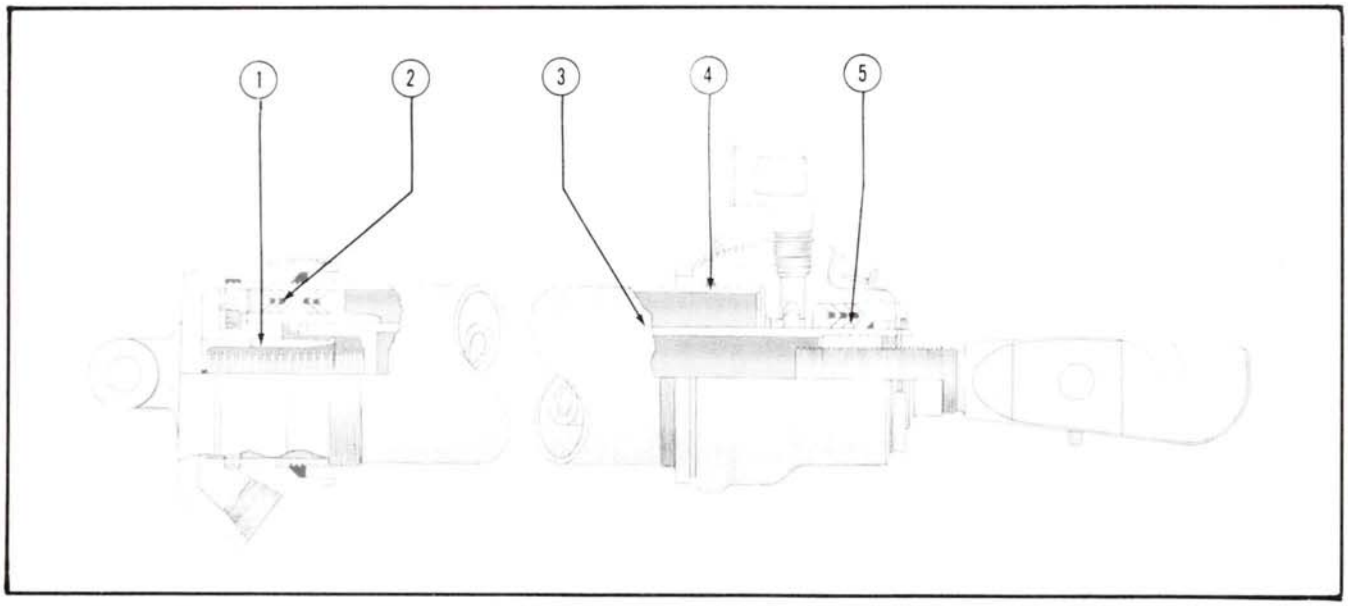


Figure 396—Rework Tolerances of Landing-Gear Actuating Cylinder—C-47A and Early C-47B Airplanes

1. If diametral clearance between dashpot and nut exceeds .004, rework to .001 to .002 by chrome plating dashpot. Dashpot may be chrome plated .010 on a diameter.
2. If diametal clearance between spacer and cylinder exceeds .020, rework to .004 to .010 by replacing spacers.
3. Manufacturing dimension of piston 1.498 to 1.495.
4. Manufacturing dimension of cylinder 2.567 to 2.562.
5. If diametral clearance between nut and rod exceeds .020, rework to .007 to .002 by reworking rod or replacing nut.

Note

The piston may be ground to a minimum of .020 undersize. Piston may be chrome plated a maximum of .020 on a diameter.

The cylinder may be honed a maximum of .020 oversize.

c. Use ample approved thread lubricant on all threads.

d. On later airplanes replace and libricate all old rings with AN-G-15 or other approved lubricant upon installation.

2. INSTALLATION.—To install the landing gear actuating cylinder, reverse the removal procedure as outlined in paragraph 13.*c.*(3)*(b)* preceding.

(g) MAJOR OVERHAUL.

1. Remove and disassemble the landing gear actuating cylinder as instructed in paragraph 13.*c.*(3)*(b)* preceding.

2. Refer to figure 396 for rework tolerances.

3. All parts of the disassembled actuating cylinder will be washed thoroughly in clean hydraulic fluid, Specification No. MIL-O-5606, before any repairs are attempted.

4. Inspect all wearing surfaces for evidence of scratches and abraded areas. Light scratches and abrasions should be buffed out carefully. Long, deep scratches may allow considerable fluid leakage and the parts with deep scratches should be replaced with new parts.

5. Do not exceed the rework tolerances specified under figure 396 for early airplanes **or figures 391-391A** for later airplanes or the packing may be extruded between adjoining parts.

6. All packing removed during disassembly should be replaced with new parts even if no fluid leakage has been observed. Packing in service for some

KEY TO FIGURE 397

1. Upper Fitting
2. Bolt
3. Balancer Line Connection — Connector, Gasket, Washer, Sleeve, and Nut
4. Piston Tube
5. Outer Cylinder
6. Inner Cylinder Bearing
7. Lock Screw
8. Snubber Valve
9. Metering Pin
10. Packing Washer
11. Packing Spacer
12. Packing Nut
13. Piston Packing (Synthetic Rubber and One Leather Packing on Some Airplanes)
14. Packing Spacer
15. Bearing
16. Felt Bearing on Some Airplanes (AN6231-33 Wiper Ring on Some Airplanes)
17. Lock Screw and Lock Wire (on Some Airplanes)
18. Piston Lock Screw
19. Piston
20. Piston Insert
21. Inner Cylinder Diaphragm
22. Lock Ring (on Some Airplanes)
23. Lock Washer
24. Nut
25. Axle Clamp Bolt
26. Lower Clamp
27. Axle Clamp Bolt Nut

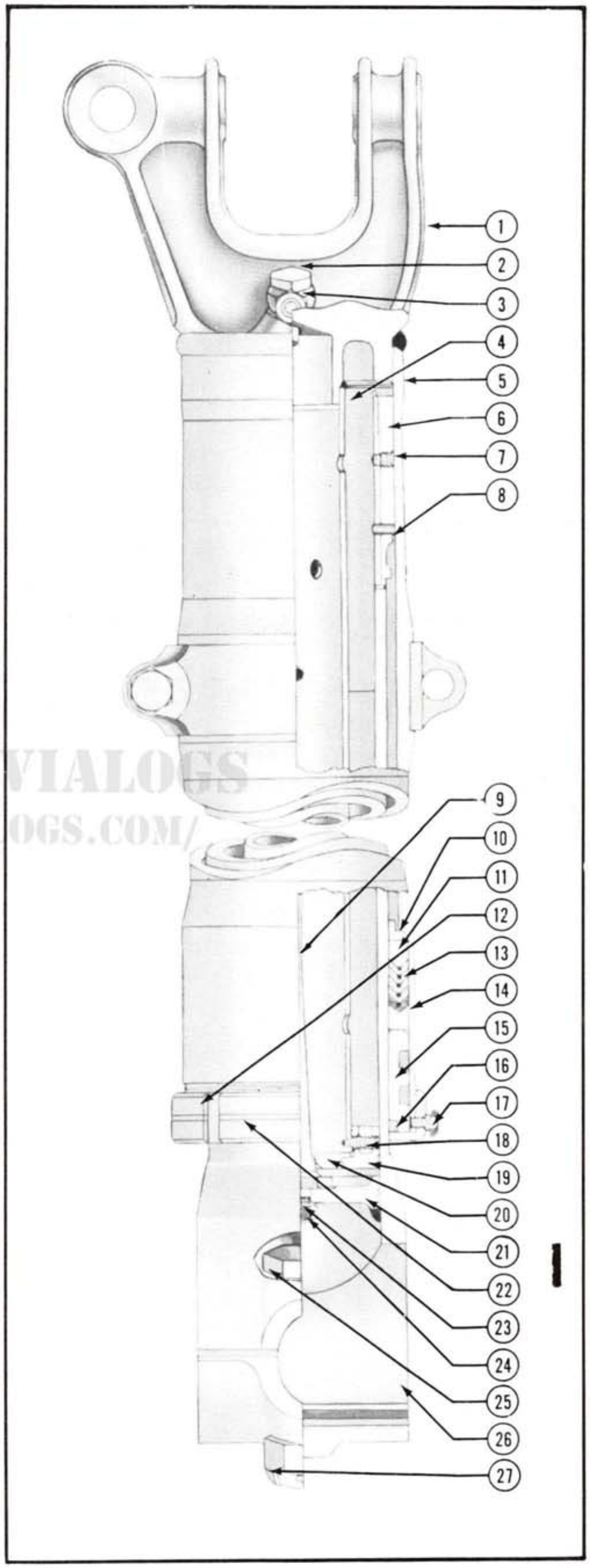


Figure 397—Main Landing-Gear Shock Strut Assembly

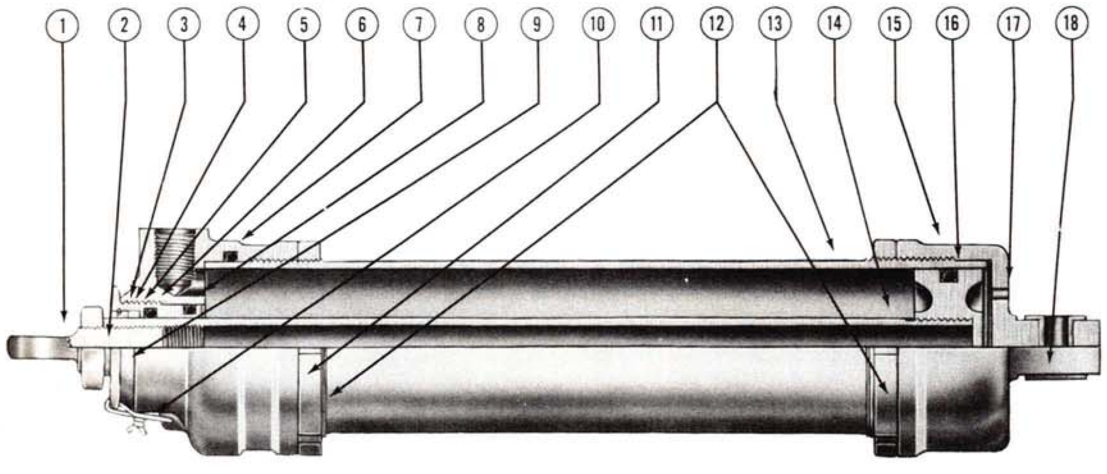


Figure 398—Landing-Gear Hydraulic Compensator Assembly

(Aircraft Accessories No. 22087, Burbank, Calif.)

1. Piston Rod Eyebolt
2. AN316-10R Nut
3. Lock Ring
4. Scraper
5. Felt Wiper
6. AN6227-16 Packing
7. AN6230-7 Packing
8. AN6227-18 Packing
9. Bushing
10. Lock Wire
11. End Cap
12. Lock Nut
13. Cylinder Barrel
14. Piston Assembly
15. End Cap
16. AN6227-31 Packing
17. Air Bleed Hole
18. End Cap Bushing

time tends to take a permanent "set" with reference to adjacent parts and may not seal properly if removed and reinstalled.

CAUTION

> Great care must be used when installing the packing rings; they are easily cut by the threads on the actuating cylinder parts. Cover the threads with thin shim stock to prevent cutting the packing rings.

7. Inspect all other parts of the actuating cylinder for wear or damage, and install new parts if necessary.

8. Reassemble the landing gear actuating cylinder and test for fluid leakage according to figure 391.

(4) LANDING GEAR HYDRAULIC COMPENSATOR. *(See figure 398.)*

(a) DESCRIPTION.—On later airplanes the elastic shock cord bungee on the landing gear was replaced with a hydraulic compensator to aid the landing gear actuating cylinder in retracting the landing gear. The compensator cylinder is connected to the landing gear UP line by a flexible hose. The upper end of the compensator is bolted to a bracket mounted on the wing front spar and the compensator piston rod is bolted to the landing gear upper truss. When the landing gear is retracted, fluid under pressure from the landing gear UP line flows through the flexible hose to the lower end of the compensator, forcing the piston to retract. The retracting piston assists the main landing gear actuating cylinder in quick retraction of the landing gear. When the compensator piston retracts, air in the compensator escapes through a small hole in the upper end of the compensator. When the landing gear is extended, the compensator piston is extended by the weight of the gear and the fluid in the compensator flows through the flexible hose into the landing gear UP line and returns to the hydraulic reservoir. Air flows through the hole in the upper end of the compensator, preventing a vacuum being created in the compensator when the compensator piston is extended.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Install ground safety pins in both landing gear upper trusses. (See figures 130 and 131.)

b. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

c. Disconnect and cap the flexible hose that leads to the compensator cylinder.

d. Remove the bolt that attaches the upper end of the compensator to the bracket. Remove the bolt that attaches the compensator piston rod to the upper truss and remove the compensator from the airplane.

2. DISASSEMBLY.—Do not attempt disassembly of the compensator in the field. When disassembly is undertaken refer to figure 398 and observe the following instructions:

a. Provide a suitable hardwood clamp that completely encircles the full length of the compensator barrel. Place the clamp and compensator in a vise and tighten the vise until the compensator is held securely.

DO NOT place the compensator in a vise or the cylinder barrel will be damaged or distorted.

b. Remove the snap ring from the piston rod packing nut; remove the wiper ring and felt wiper.

c. Cut the lock wire and unscrew the piston rod packing nut.

d. Unscrew the lock nut from the end cap. Remove the end cap from the cylinder barrel.

e. Remove the piston assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the hydraulic compensator is damaged or is not functioning properly, install a new part.

(d) ADJUSTMENTS.—Refer to this section, paragraph *4.b.*(5)*(b)4.* for adjustment of the hydraulic compensator with the landing gear mechanism.

(e) TESTS BEFORE INSTALLATION. – To test the landing gear hydraulic compensator for fluid leaks apply 1500 psi pressure at the hydraulic port. No leaks are permissible.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the hydraulic compensator refer to figure 398 and reverse the disassembly procedure.

Note

Tighten the lock nuts on the compensator end caps to a torque of 225 inch-pounds.

2. INSTALLATION.—To install the compensator reverse the removal procedure. To adjust the compensator refer to paragraph *4.b.*(5)*(b)4.*, this section.

(g) MAJOR OVERHAUL.

1. Remove and disassemble the compensator in accordance with preceding instructions.

2. Inspect all wearing surfaces of the compensator for excessive wear and deep scratches. Install new parts if necessary. Light scratches or abraded areas may be buffed out carefully.

3. Install new packing, even if no fluid leakage has been observed.

4. Check all remaining parts for defects and make necessary replacements with new parts.

5. Assemble the compensator and test for fluid leaks.

(5) LANDING GEAR SHOCK ABSORBER STRUT. *(See figure 397.)*

(a) DESCRIPTION.—Each main landing gear wheel is mounted between two air-oil shock absorber struts. Both air and fluid are utilized in the shock absorber struts to produce controlled resistance during the taking off or landing of the airplane.

1. COMPONENT PARTS.—The major component parts of the shock strut are as follows.

a. Two telescoping chambers with the lower chamber always filled with fluid and the upper chamber which has compressed air in the top and fluid in the bottom when the strut is in the operating condition.

b. An orifice between the two chambers, through which the fluid passes into the upper chamber when the strut is compressed and returns when the strut is extended.

c. A variable section pin known as a metering pin which automatically controls the area of the orifice at all points in the stroke of the strut.

d. Provisions on the end of the lower or inner cylinder for installation of an axle.

e. A damping device consisting of a snubber valve to reduce rebound during the extension stroke of the strut.

f. Suitable connections to allow proper attachment to the airplane.

g. A packing gland consisting of molded packing rings with aluminum spacer rings designed to seal the sliding joint of the upper and lower chambers.

h. Bronze bearings fitted to the outer and inner cylinders to maintain their correct alignment as well as to minimize friction at the bearing surfaces.

i. A fitting consisting of a filler inlet and an air pressure valve, located at the top end of each strut, and a fitting for a balancing line connection, also located at the top of the strut. A tube connects the two struts in a pair to equalize the air pressure in the two struts.

Note

A stripe of yellow paint around the periphery of the strut outer cylinder indicates -65°F synthetic "V" ring packings are installed.

2. OPERATION.—The compression stroke of the strut is the initial movement of the strut and occurs when the impact load of the landing airplane is applied to the landing gear. The lower or inner cylinder moves farther into the outer cylinder, reducing the volume of the lower chamber and forcing the fluid to leave the lower chamber. The oil flows from the lower chamber through the orifice into the piston tube. The flow of oil through the orifice is automatically controlled at all points of strut compression and extension by the variable section of the metering pin which attaches to the lower cylinder and projects through the orifice.

The fluid in overcoming the resistance to its flow through the orifice absorbs the greater portion of the impact energy of the landing airplane. The energy absorbed by the fluid is converted into heat and dissipated. Compression of the strut stops when the entire impact load of the landing airplane has been absorbed by the fluid and by the compression of the air in the upper chamber. Expansion of the strut takes place after a sufficient compression stroke has been made to absorb the energy of impact. As the impact load decreases, the

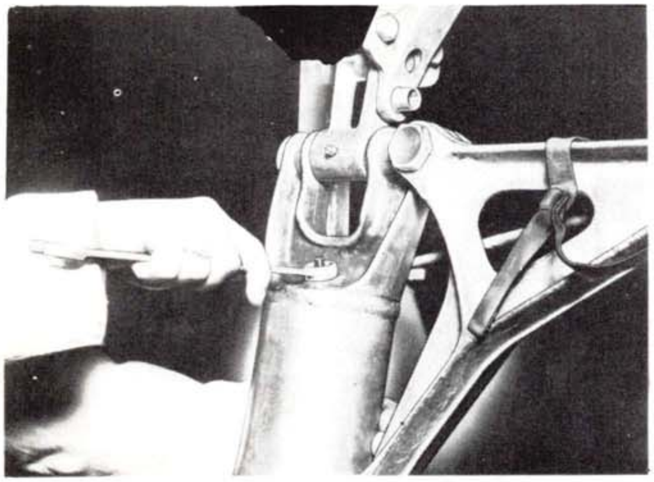


Figure 399—Releasing Air Pressure in Shock Strut by Backing Off Filler Plug

air which has been compressed in the upper chamber expands causing the strut to extend. The snubber valve is closed instantly by the returning fluid. The fluid must flow through two small holes 180 degrees apart in the snubber valve before flowing through the holes to the annular chamber. As the strut extends, the fluid is forced into the piston tube; then through the orifice, into the lower chamber. By forcing the fluid to return through the small holes in the snubber valve during the extension stroke, the extension of the strut is slowed by the resistance to the flow. This reduces rebound of the strut in two ways: by actually absorbing energy and converting it to heat; and by changing the natural period of oscillation in such a way that it damps out the tire oscillation.

(b) REMOVAL.—To remove the shock strut from the airplane refer to paragraph *4.b.*(4)*(b)*, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. CLEANING.—Clean the piston tubes of all landing gear shock struts with a cloth soaked in hydraulic fluid conforming to Specification No. MIL-O-5606 before and after flight. If hard dirt or grit is encountered and difficulty is experienced in cleaning the piston tubes, use kerosene as a solvent to remove the grit, and lubricate the piston tubes again with a cloth soaked in hydraulic fluid as specified above.

2. FILLING PROCEDURE.

a. Deflate each pair of struts by backing off the air valve filler plug of one strut slightly (figure 399) and allowing the air to escape slowly past the copper gasket at the plug seat. This will prevent damage to the valve core caused by the sudden rush of high pressure past the valve core seat. Back off the filler plug until all "fizzing" of air and fluid ceases. Do not attempt to remove the filler plug without first deflating the strut in this manner. Always use a wrench to remove or install the filler plug; never use pliers.

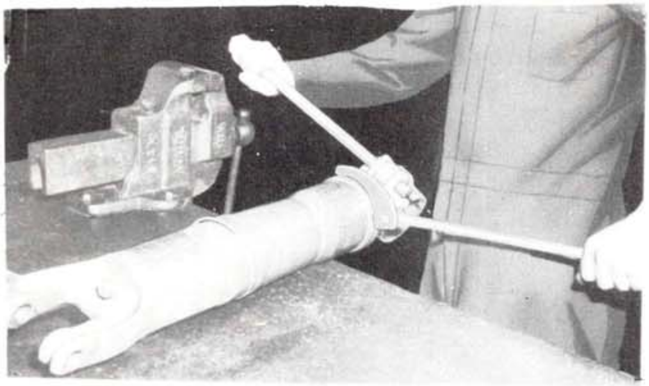


Figure 400—Use of Shock Strut Packing Nut Wrench (Service Tool No. K26414)

b. Remove the filler plug and check the fluid level, which should be flush with the filler hole when the strut is fully collapsed and the airplane is in the normal taxying position.

c. Fill the strut through the filler hole with hydraulic fluid, Specification No. MIL-O-5606, until the fluid is level with the hole. To completely fill the strut 5⅛ pints of hydraulic fluid are required.

d. Insert the filler plug loosely and cause the strut to completely extend and collapse several times by raising and lowering the airplane with a hoist or jack to eliminate air traps in the strut.

e. Remove the filler plug and again check the fluid level. The procedure outlined above will be repeated each time until the proper fluid level is obtained.

f. Install the filler plug carefully to avoid damage to the threads or the air valve stem. Install a new copper gasket and then tighten the air valve firmly.

3. INFLATION.

a. With the fluid at the proper level, the strut may be inflated through the air valve by any of the following available means:

(1) By using a hand-operated high-pressure air pump in conjunction with shop line pressure, a portable air compressor, or a hand-operated low-pressure tire pump.

(2) By using a high-pressure booster pump in conjunction with shop line pressure or a portable air compressor.

b. Rock the airplane while inflating the struts, so that the strut will extend and compress alternately to overcome packing friction. When fully inflated the struts must have an extension of 4 ± ¼ inches as specified by the instructions stencilled on the struts. A variation of plus or minus ¼ inch is permissible. The inflated strut extension is measured from the top edge of the axle to the bottom edge of the packing nut. The approximate air pressure with the strut fully extended is 160 psi.

WARNING

Compressed oxygen must never be used to inflate the shock struts.

c. Any checking or adjusting of strut inflation should be done when the airplane is resting on a reasonably level surface, sheltered from the wind, fully loaded, and in taxying position. Be sure that the struts have been extended and compressed several times before any checking or adjusting is done.

d. Overinflation of the struts must not be corrected by depressing the air valve core. To reduce the air pressure, the filler plug should be backed off and tightened again rapidly. The airplane should be rocked, if possible, when the air is being released.

e. After new oil is added to the shock strut a certain amount of deflation may result. When this condition is found, check for air leaks. If no air leaks are discovered, inflate the strut to its proper height.

4. AIR VALVES.

a. After the strut is inflated, test the air valve, valve core, and filler plug carefully for leakage by using soapy water. Leaks around the filler plug or valve usually will be evident by a seepage of fluid.

b. Care must be exercised to prevent damaging the filler plug and air valve assembly by excessive tightening of the air-hose connection and by improper use of tools. If the lip of the air valve body is damaged, a new part should be installed.

c. Air valve caps should be used at all times. This cap not only protects the air valve core from dirt and water but also aids in sealing the air in the shock strut. Tighten the air valve caps (painted yellow) to a torque of 15 to 25 inch-pounds with a small wrench.

5. PACKING.

a. If fluid leakage of the shock strut occurs at the packing gland, as evidenced by fluid seepage or by air bubbles when the soapy water is applied, tighten the packing nut firmly with hand pressure or by using service tool No. K26414 (figure 400). Air pressure must be released by backing off the filler plug before tightening the packing nut as the packing cannot be tightened properly under pressure. If moderate tightening will not stop the fluid leakage, the packing must be replaced.

b. Replacement of the shock strut packing is an operation that requires great care to prevent damage to the packing. Whenever possible this work should be done by a depot or service squadron as follows:

(1) Remove the shock strut from the airplane as instructed in paragraph *4.b.*(4)*(b)1.*, this section.

(2) Relieve all air pressure in the shock strut by backing off the filler plug (figure 399) until all "fizzing" of the air and fluid stops.

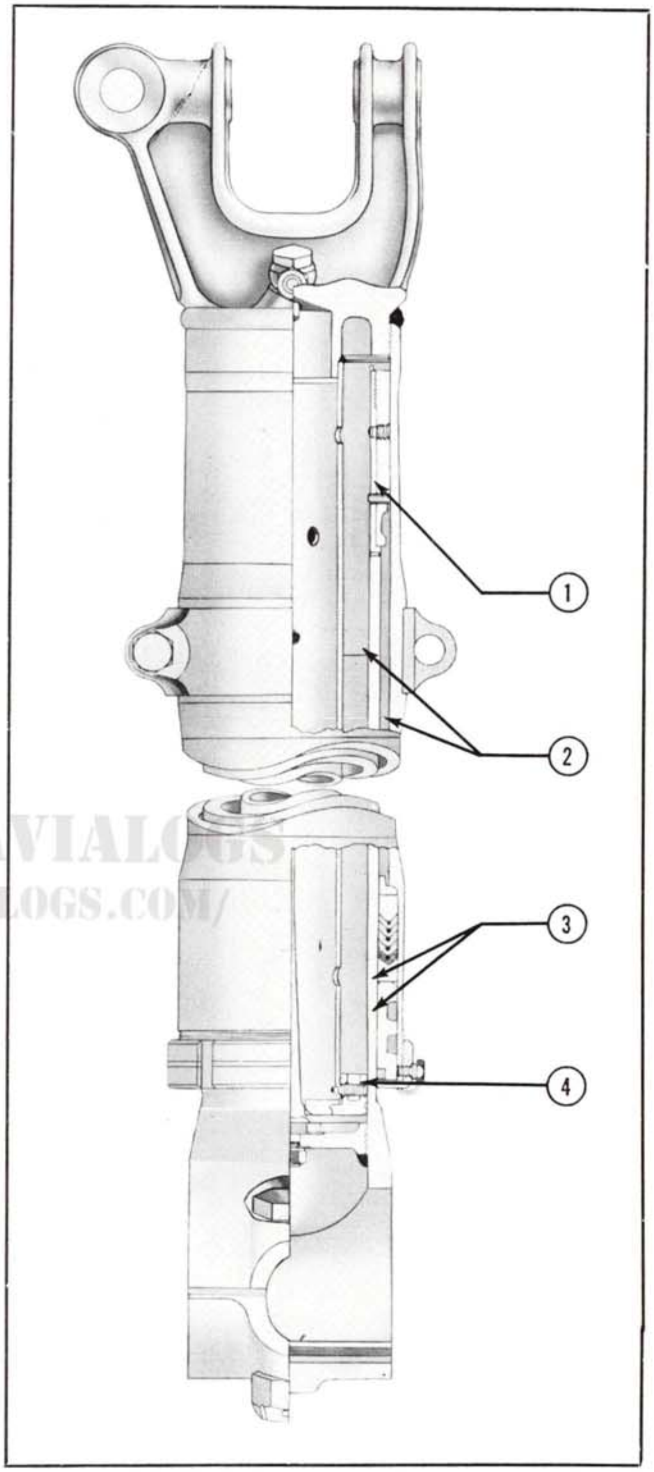


Figure 401—Rework Tolerances of Landing-Gear Shock Absorber Strut

1. If diametral clearance between bearing and cylinder exceeds .019, rework by replacing bearing.
2. Cylinders may be honed a maximum of .020 oversize.
3. If diametral clearance between spacer, lower bearing, and inner cylinder exceeds .022, rework by replacing bearing and spacer.
4. If diametral clearance between piston head and inner cylinder exceeds .010, rework by replacing piston head.

(3) Remove the filler plug and drain the hydraulic fluid from the shock strut. Remove the dust excluder, if installed.

Note

> On later airplanes, a steel scraper ring replaced the felt bearing in the landing gear shock strut assembly and dust excluders were not installed on the shock struts.

(4) Unscrew the packing nut with service tool No. K26414 (figure 400), taking care to remove all safetying devices.

(5) Pull out the piston tube assembly, using a slight bumping action, if necessary, to loosen the packing.

(6) Remove the lock screw from the inner cylinder bearing. Unscrew the bearing from the inner cylinder; take care to avoid damage to the threads or outside surface of the bearing. Remove the snubber valve from the inner cylinder.

(7) Remove the packing and install new packing in the same arrangement, as shown in figure 397. Use only the packing specified for this shock strut. Wet the packing with hydraulic fluid, Specification No. AN-VV-O-366, before installation.

(8) After the packing, spacers, and washers have been placed in the piston, install the snubber valve and bearing on the inner cylinder. Tighten the lock screw on the bearing.

(9) Insert the piston carefully into the cylinder. Install each packing into the packing gland separately. Take great care to avoid roughening, tearing the lips of the packing. After the packing is installed, place the packing nut on the cylinder. Tighten the packing nut firmly but not excessively.

(10) If facilities are available, the shock strut should be run in after replacing the packing. This should be done on a machine which will move the piston in and out through at least half of its total travel, a minimum of 100 cycles. The shock strut should be fully serviced with oil and air, before it is run in.

6. REPLACEMENT.—If the shock strut is damaged or not functioning properly, it should be replaced with a new or serviceable strut.

(d) INSTALLATION.—To install the shock strut refer to paragraph *4.b.(4)(d)*, this section.

(e) MAJOR OVERHAUL.—Rework tolerances are listed on figure 401.

(6) TAIL WHEEL SHOCK STRUT.
(See figure 402.)

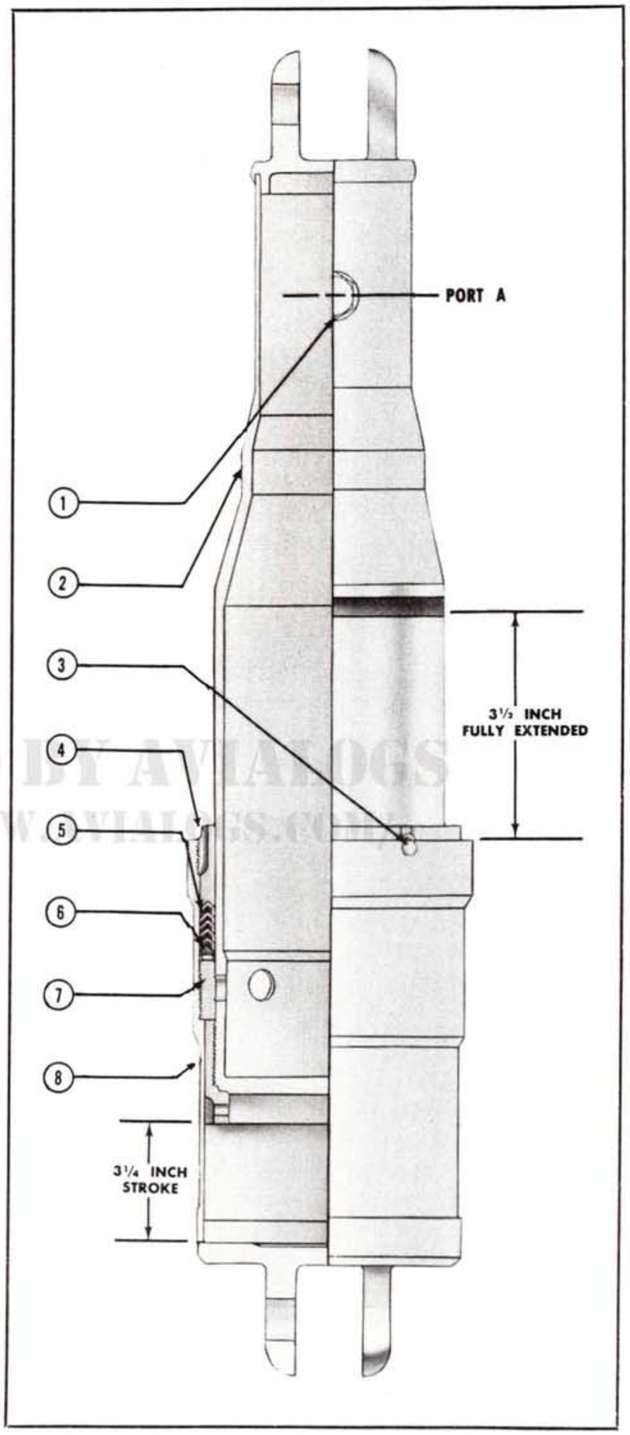


Figure 402—Tail Wheel Shock Absorber Strut Assembly

(a) DESCRIPTION.—The air-oil tail wheel shock absorber strut is mounted between the tail wheel spindle and the tail wheel fork to absorb the impact and taxying loads on the tail wheel. The shock strut piston is bolted to the spindle and the strut cylinder is bolted to the tail wheel fork. When the airplane is in flight the shock strut is in the extended position and the hydraulic fluid is in the lower cylinder chamber. When the tail wheel strikes the ground, the cylinder is forced upward, forcing the hydraulic fluid through the hole in the piston into the upper chamber of the shock strut. As the shock strut retracts, the rising fluid compresses the air in the strut. The impact energy is absorbed by forcing the fluid through the hole in the piston and converting the energy into heat. When the

KEY TO FIGURE 402

(Douglas Dwg. No. 5115222)

TEST PROCEDURE

Test Port	*Test Pressure*	*Position*	*Max. Leakage*
A	3000 psi oil pressure	Vertical	None evident in 3 minutes
A	610 psi air pressure	Vertical	None evident in 4 hours
A	610 psi air pressure	Horizontal	None evident in 4 hours

Item	*Part No.*	*Part Name*	*No. Req*
1	143908-016C024-032	Copper Gasket	1
	7067A	Schrader Valve Assembly With Either Schrader No. 2525 or Dill No. 637 Valve Cap and with Either Schrader No. 2300 or Dill No. 302D Air Valve Core	1
	or		
	SK1517A	Dill Valve Assembly With Either Schrader No. 2525 or Dill No. 637 Valve Cap and With Either Dill No. 302D or Schrader No. 2300 Air Valve Core	1
2	3115048	Piston Assembly	1
	Consists of:		
	3115288	Piston	1
	2115286	Head	1
	2115285	Retainer	1
3	132100-4-3A	Bolt {Replaced by 2206087 Lock	1
	AF995-C40-4	Lock Wire } Ring on Some Airplanes	1
4	2115051	Packing Nut	1
5	5135865-5-400	Garlock Packing	5
6	1012954-D400-010	Ring	1
7	2115049	Retainer	1
8	4115054	Cylinder	1
		NOTE: Yellow paint stripe on piston indicates that all packing is made of synthetic rubber.	

shock strut has retracted sufficiently to absorb the energy of impact, the air in the strut expands, extending the strut and forcing the hydraulic fluid through the hole in the piston into the cylinder. Taxying loads are absorbed mainly by the compression of air in the shock strut. A stripe of yellow paint on the piston indicates that all packing is made of synthetic rubber.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Jack the tail of the airplane as instructed in section III, paragraph 2.*b.*(2) until the tail wheel clears the ground.

b. Block the tail wheel so that it will not drop violently when the shock absorber strut is removed.

c. Remove the fairing from the tail wheel fork.

d. Remove the bolts that attach the shock strut to the spindle and tail wheel fork; remove the shock strut from the airplane.

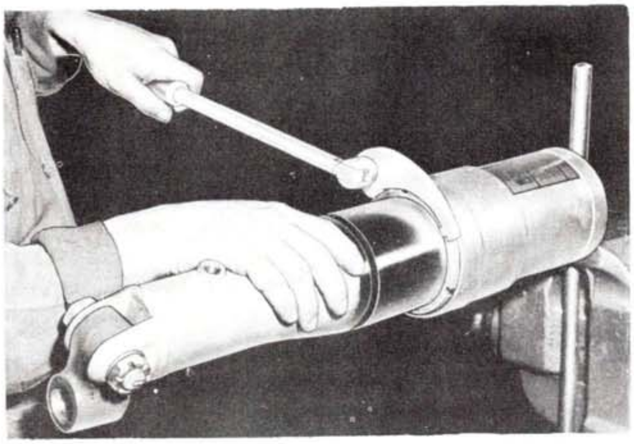


Figure 403—Use of Tail Wheel Shock Absorber Strut Packing Nut Spanner Wrench (Service Tool No. K26413)

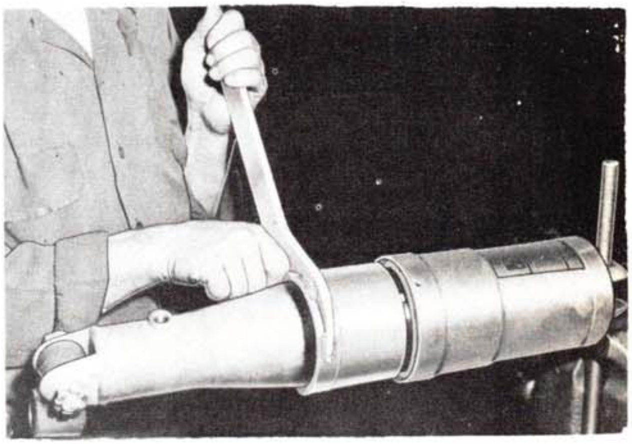


Figure 404—Use of Tail Wheel Shock Absorber Strut Interior Packing Gland Wrench (Service Tool No. K20501)

2. DISASSEMBLY.—Whenever possible, disassembly of tail wheel shock strut should be undertaken only at depots. If disassembly is undertaken, refer to figure 402 and observe following instructions:

a. The air pressure MUST be relieved from the shock strut before disassembly. Use a box wrench and back off the filler plug slightly to allow the air pressure to escape through the bleed hole in the filler plug. DO NOT release the air pressure by depressing the air valve core.

b. Remove the dust excluder, if installed, from the shock strut.

c. On C-47A airplanes unscrew the set screw in the packing adjusting nut. On C-47B airplanes this is replaced by a lock ring which should be removed.

d. Remove the packing adjusting nut from the cylinder by using service tool No. K26413 (figure 403). Use care to avoid scratching the chrome-plated portion of the piston.

e. Pry out the packing with a suitable blunt packing tool. Remove the male back-up ring.

f. Unscrew the interior packing gland nut from the cylinder, using service tool No. K20501 (figure 404).

g. The piston assembly now may be pulled from the cylinder.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. FILLING.—To fill the shock strut observe the following instructions:

a. Relieve the air pressure in the strut by backing off the filler plug slightly. Do not release the air pressure by depressing the air valve core.

b. When the air pressure has been released unscrew the filler plug from the strut. The strut should be fully retracted before fluid is added.

c. Fill the strut through the filler hole with **hydraulic fluid, Specification No. MIL-O-5606,** until the fluid level is level with the filler hole.

d. Install the filler plug carefully to avoid damage to the threads and air valve. Replace the copper gasket with a new part to prevent leaks.

2. INFLATION.—With the fluid in the strut at the proper level inflate the strut with air pressure through the air valve until the red line on the piston tube is 1-¼ ± ¼ inches from the packing gland nut. It will be necessary to raise the dust excluder to check this inflation dimension. The strut may be inflated by any of the following available means:

a. By using a hand-operated high-pressure air pump in conjunction with shop line pressure, a portable air compressor, or a hand-operated low-pressure tire pump.

b. By using a high-pressure booster pump in conjunction with shop line pressure or a portable air compressor.

c. Overinflation must not be reduced by depressing the valve core. To reduce the inflation, unscrew the filler plug and tighten again quickly.

3. AIR VALVES.

a. After the strut is correctly inflated, test the valve; the valve core, and the filler plug carefully for leaks by using soapy water.

b. Care must be used to prevent damaging filler plug and air valve assembly by excessive tightening of air-hose connection and by improper use of tools. Pliers must not be used on air valve assembly.

c. An air valve cap must be used at all times to protect the air valve core from dirt and water, and to aid in sealing the air in the shock strut. Tighten the air valve caps (painted yellow) with a small wrench to a torque of 15 to 25 inch-pounds.

4. PACKING.

a. If fluid leakage occurs at the packing gland, as shown by fluid seepage or by air bubbles when soapy water is applied, tighten the packing gland nut firmly but not excessively. The air pressure must be released from the strut before the packing can be tightened properly. Tighten the packing gland nut with service tool No. K26413 (figure 403). After the packing gland nut is tightened, check the fluid level in the strut and follow preceding instructions for inflating the strut to the proper level.

b. If tightening of the packing gland nut will not prevent fluid leakage, the packing must be replaced. Replacement of the packing is an operation that requires much care to prevent damage to the packing. Whenever possible the packing should be replaced at a depot as follows:

(1) Remove the shock strut as instructed in paragraph 13.*c.*(6)*(b)* preceding.

(2) Release the air pressure in the strut by backing off the filler plug. When all of the air pressure has been released, remove the filler plug.

(3) Pour hydraulic fluid from strut.

(4) Remove the packing gland nut by using service tool No. K26413 (figure 403).

(5) Pry out packing with a suitable blunt tool. To remove interior packing gland nut use service tool No. K20501 (figure 404).

(6) Install new packing. Cover the cylinder threads with thin shim stock to protect the packing. Wet the packing with hydraulic fluid, Specifica**tion No. MIL-O-5606, and install one packing at a** time.

(7) When the packing is installed and firmly seated, install the packing gland nut. Tighten the packing gland nut only as much as necessary to prevent fluid leakage.

(8) Fill the strut with hydraulic fluid and test for leaks as specified in figure 402.

(9) Install the shock strut on the airplane by reversing the removal procedure as given in paragraph 13.*c.*(6)*(b)*. Inflate the strut as instructed in paragraph 13.*c.*(6)*(c)2.*

(d) TESTS BEFORE INSTALLATION.—Refer to figure 402 for leak tests of the tail wheel shock strut.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the tail wheel shock strut refer to figure 402 and reverse the disassembly procedure as outlined in paragraph 13.*c.*(6)*(b).*

2. INSTALLATION.—To install the shock strut reverse the removal procedure as outlined in paragraph 13.*c.*(6)*(b).*

(f) MAJOR OVERHAUL.

1. Remove and disassemble the tail wheel shock strut as instructed in paragraph 13.*c.*(6)*(b).*

2. Refer to figure 405 for rework tolerances of the shock strut.

3. Replace all packing with new packing.

4. Inspect all parts for wear and make necessary replacements with new parts.

5. When repair of the shock strut is complete, assemble the strut and test for leaks as specified in figure 402.

d. BRAKE HYDRAULIC SYSTEM. *(See figure 406.)*

(1) GENERAL.—The main landing gear wheel brakes may be applied independently or simultaneously by means of two brake control valves which are contained in a single housing and linked to the rudder-brake pedals. Application of toe pressure on the rudder-brake pedals allows hydraulic fluid under pressure to flow through the brake control valves and brake operating lines to the brake actuating cylinders. The brake actuating pistons are forced outwardly and in turn force the brake shoes against the brake drums to produce the braking action. When the rudder-brake pedal is released, springs return the brake shoes to the "OFF" position, the brake actuating pistons are forced inward, and the excess hydraulic fluid flows through the brake operating lines to the brake control valve and into the return line to the hydraulic reservoir. A parking brake mechanism is provided to hold the rudder-brake pedals in the "ON" position.

(2) BRAKE CONTROL VALVE. *(See figure 408.)*

(a) DESCRIPTION.—The brake control valve

KEY TO FIGURE 405

1. Manufacturing dimension of piston 4.000 to 3.997.
2. If diametral clearance between spacer and piston exceeds .020, rework to .002 to .008 clearance by chrome plating piston or replacing spacer.
3. If diametral clearance between 2115049 retainer and piston exceeds .020, rework to .002 to .008 clearance by chrome plating piston or replacing retainer.
4. If diametral clearance between 2115285 retainer and cylinder exceeds .020, rework to .002 to .008 clearance by replacing retainer.
5. Manufacturing dimension of cylinder 4.376 to 4.380.

Note

Piston may be ground to a minimum of .020 undersize. Chrome plate a maximum of .020 on a diameter. Chrome plate bearing surface only. The cylinder may be honed a maximum of .020 oversize.

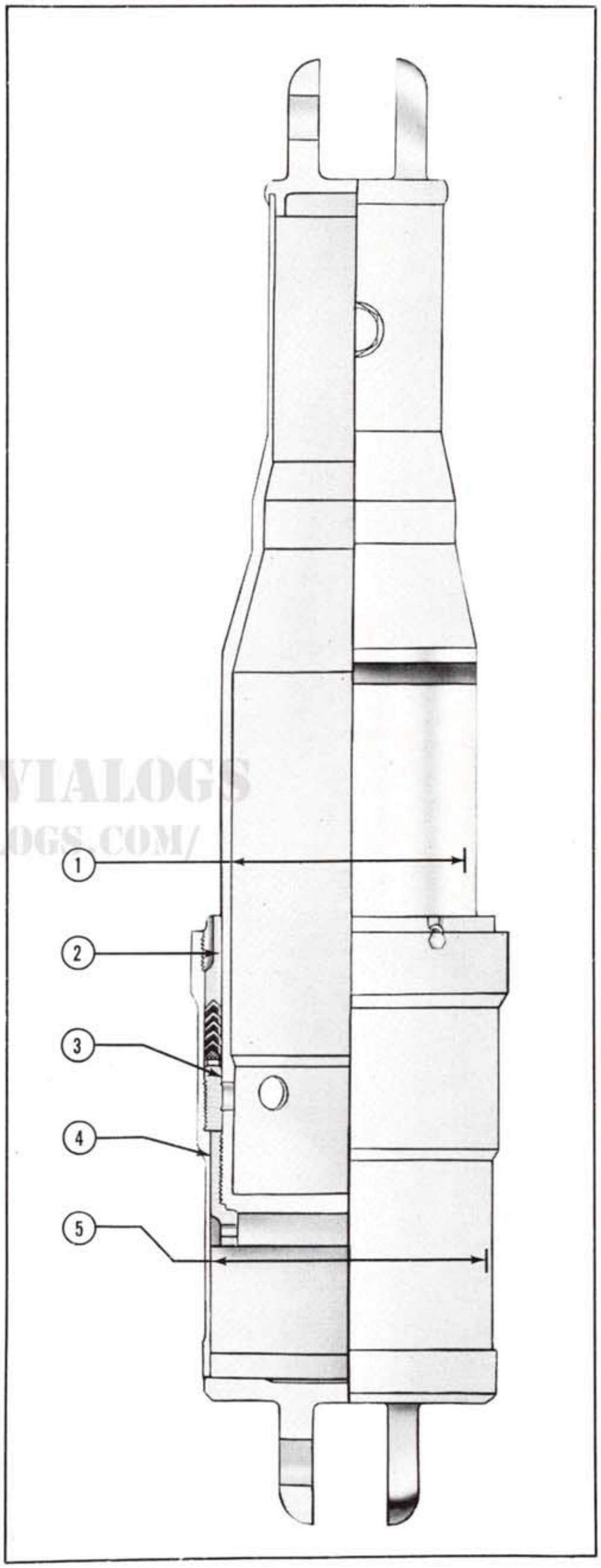
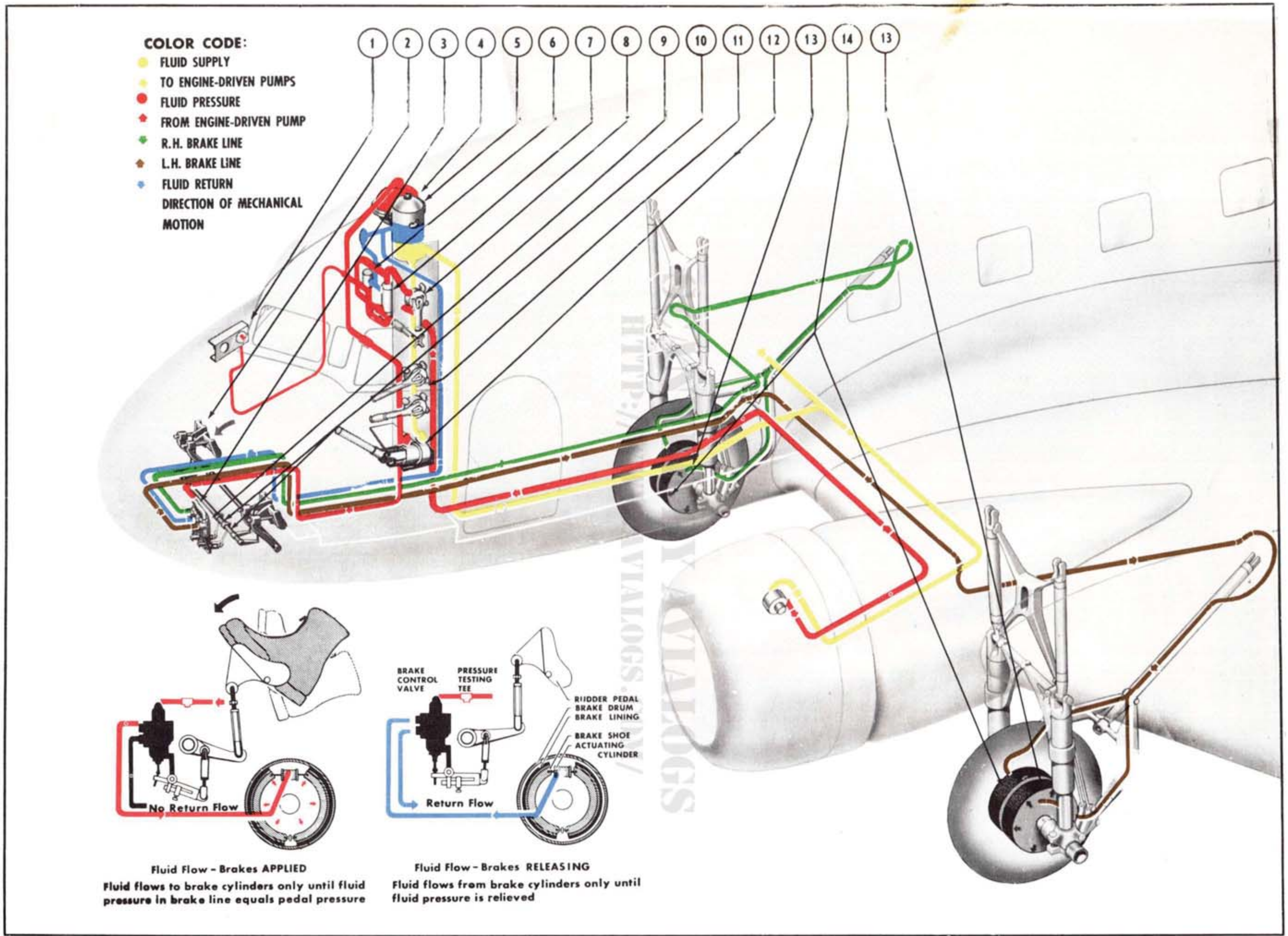


Figure 405—Rework Tolerances of Tail Wheel Shock Absorber Strut


COLOR CODE:
● FLUID SUPPLY
● TO ENGINE-DRIVEN PUMPS
● FLUID PRESSURE
● FROM ENGINE-DRIVEN PUMP
● R.H. BRAKE LINE
● L.H. BRAKE LINE
● FLUID RETURN
DIRECTION OF MECHANICAL MOTION
1
2
3
4
5
6
7
8
9
10
11
12
13
14
13
No Return Flow
BRAKE CONTROL VALVE
PRESSURE TESTING TEE
RUDDER PEDAL
BRAKE DRUM
BRAKE LINING
BRAKE SHOE ACTUATING CYLINDER
Return Flow

Fluid Flow - Brakes APPLIED

Fluid flows to brake cylinders only until fluid pressure in brake line equals pedal pressure

Fluid Flow - Brakes RELEASING

Fluid flows from brake cylinders only until fluid pressure is relieved

Figure 406—Brake Hydraulic System

KEY TO FIGURE 406

(Douglas Dwg. Nos. 5110513, 5141942, 5110553, 5141943, 5110568, and 5203619)

1. Hydraulic System Pressure Gage
2. Rudder—Brake Pedals (See figure 413)
3. Check Valve
4. Hydraulic System Pressure Accumulator (See figure 367)
5. Hydraulic System Fluid Reservoir (See figure 374)
6. Hydraulic System Pressure Relief Valve (See figure 375)
7. Hydraulic System Pressure Regulator (See figure 368)
8. Engine-Driven Hydraulic Pump Selector Valve (See figure 366)
9. Brake Control Valve (See figures 407 and 408)
10. 1139436 Link (Upper)—2 req
    1119764 Link (Lower)—2 req
    AN316-5R Nut—2 req
    AN960-10 Washer—4 req
    AN380-2-2 Cotter—4 req
    AN3-7 Bolt—4 req
    AN310-3 Nut—4 req
11. Hydraulic Control Panel (See figure 361)
12. Hydraulic Hand Pump (See figure 376)
13. Brake Disconnect Couplings
14. Brake Assemblies

Note

For tubing and fittings information refer to figure 640, section VIII.

provides a means of supplying hydraulic fluid at a controlled pressure and quantity to the wheel brakes with the same "feel" or sensitivity as obtained with manually operated brakes. The brake control valve is mounted on a bracket in the nose section of the fuselage. The valve consists of an aluminum-alloy housing (figure 409) which contains two piston chambers. Each piston chamber has a port to connect to the brake operating line. The pressure port and return port serve both piston chambers. A system of rods and levers connects the brake valve pistons and rudder-brake pedals. The operation of the brake control valve is as follows (figure 407): Application of toe pressure to the rudder-brake pedal is transmitted to the "tuning fork" arm of the brake valve and the brake valve piston and pin is moved upward, unseating the inlet valve ball. Hydraulic fluid under pressure then flows into the piston chamber and into the brake operating line, actuating the brake pistons and brake shoes. The hydraulic fluid continues to flow to the brake operating line until the force exerted by the fluid pressure in the brake operating line equals the force applied on the rudder-brake pedals. The fluid pressure then forces the piston down and the inlet valve ball is seated. Piston thrust is taken up by deflection of the "tuning fork" so that fluid pressure is felt at the rudder-brake pedals. Brakes are applied according to the amount of pedal pressure and there is no noticeable lag in this operation of the brake valve. When pressure on the rudder-pedal is released, the piston moves down and a fixed pin in the piston unseats the outlet valve. The excess fluid in the brake operating line flows back through two holes in the valve piston into the return line to the reservoir. A check valve, installed in the pressure port of the brake control valve, prevents back flow of fluid from the brake control valve.

(*b*) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

b. Disconnect and cap the hydraulic lines leading to the brake control valve.

c. Disconnect the rudder-brake pedal operating linkage from the "tuning fork" arms of the brake control valve.

d. Remove the bolts that attach the brake control valve to the bracket and remove the valve from the airplane.

2. DISASSEMBLY.—The brake control valve should not be disassembled except at repair depots where the proper tools and adequate testing facilities are available. If disassembly is attempted refer to figure 408.

(*c*) MAINTENANCE REPAIR OR REPLACEMENT.—Replace the brake control valve if it is damaged or is not functioning properly.

(*d*) ADJUSTMENTS.

1. BLEEDING THE BRAKES.—Before the brake control valves can be adjusted properly, the brake hydraulic system must be bled by observing the following procedure:

a. Check to see that the hydraulic fluid reservoir is filled to the proper level. It will be necessary to keep a careful check on the fluid in the reservoir during the bleeding operation to be certain that the reservoir does not become empty.

b. Remove the cap or screw from the bleeder fitting on both the inboard and outboard brake of one wheel and attach bleeder hoses to the bleeder valves.

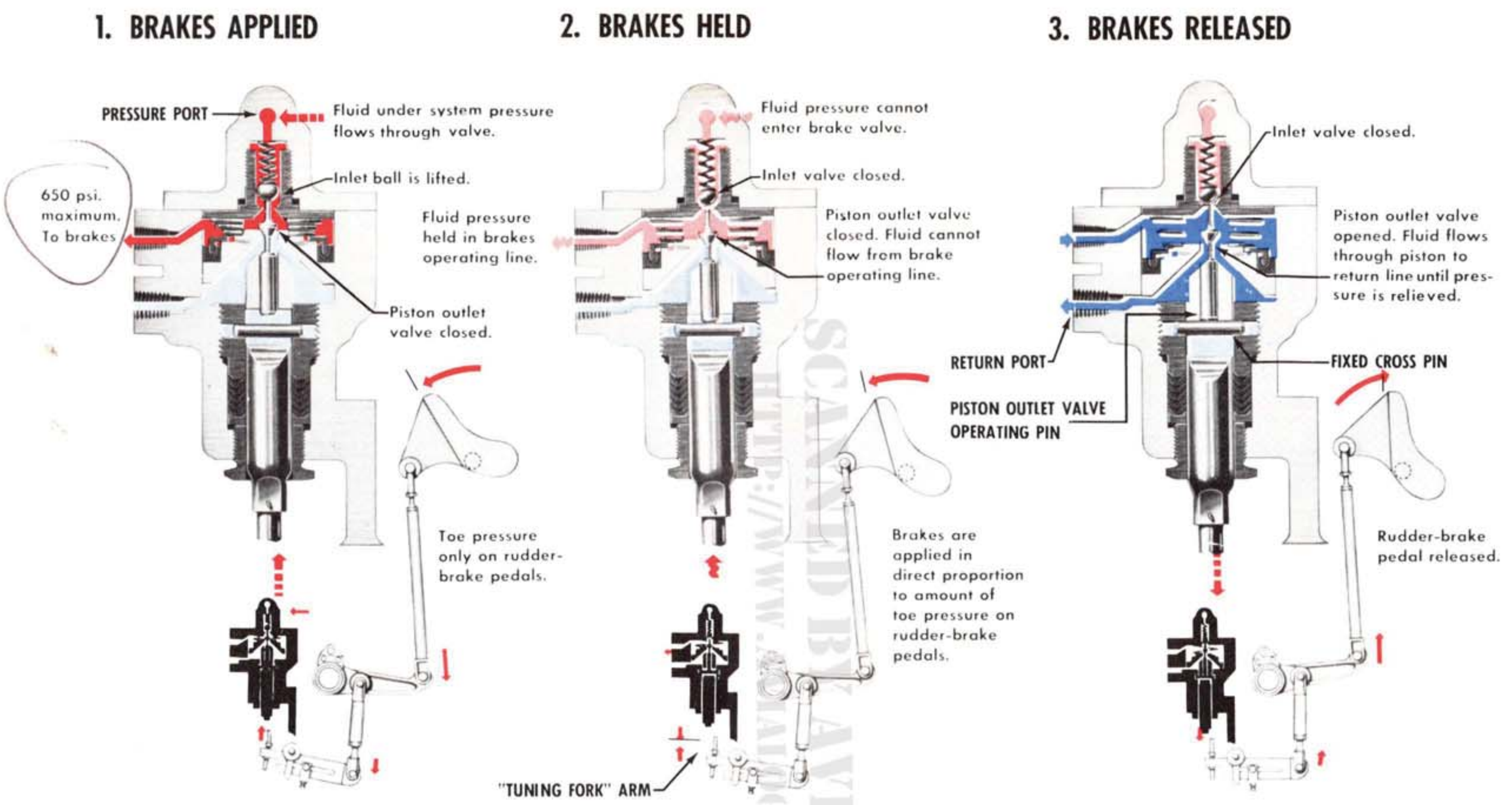
Note

> To bleed the brake hydraulic system without disturbing the brake control valve adjustment, it is only necessary to set the parking brake and open the brake bleeder fitting as shown in figure 410.

c. Remove the access door on the bottom of the nose of the fuselage to gain access to the brake control valve. Slide the high-pressure adjusting clamp on the brake valve "tuning fork" arm all the way forward.

d. If a test stand is not available, operate the hydraulic hand pump to obtain 875 psi in the hydraulic system.

e. Back off the bleeder fitting (figure 410) and turn in the low-pressure adjusting screw on the brake control valve until a full stream of hydraulic fluid flows from the bleeder hoses. Open both bleeder fittings and allow the hydraulic fluid to flow into a clean container until a clear stream of oil, free of all air bubbles, is obtained. Close both bleeder valves simultaneously.


PRESSURE PORT
Fluid under system pressure flows through valve.
650 psi. maximum. To brakes
Inlet ball is lifted.
Fluid pressure held in brakes operating line.
Piston outlet valve closed.
Toe pressure only on rudder-brake pedals.
Fluid pressure cannot enter brake valve.
Inlet valve closed.
Piston outlet valve closed. Fluid cannot flow from brake operating line.
Brakes are applied in direct proportion to amount of toe pressure on rudder-brake pedals.
"TUNING FORK" ARM
Inlet valve closed.
Piston outlet valve opened. Fluid flows through piston to return line until pressure is relieved.
RETURN PORT
FIXED CROSS PIN
PISTON OUTLET VALVE OPERATING PIN
Rudder-brake pedal released.

1. BRAKES APPLIED

Toe pressure applied to rudder-brake pedal forces brake valve piston up, unseating ball and opening inlet valve and closing piston outlet valve. Hydraulic fluid flows from pressure line through brake valve to brake operating line. Brake actuating cylinders begin to apply brakes. Deflection of the "tuning fork" arm limits pressure in the brake operating line to a maximum of 650 psi.

2. BRAKES HELD

Toe pressure is still applied. Fluid pressure forces piston down, closing inlet valve, piston thrust is taken up through deflection of "tuning fork." This deflection increases until force exerted by fluid pressure on piston equals force exerted on piston by pedal pressure. Fluid pressure is felt at pedal. Brakes are applied to a degree depending on amount of pedal pressure.

3. BRAKES RELEASED

Toe pressure on rudder-brake pedal is released. Piston is forced down to non-operating position by brake actuating cylinders return springs and fluid pressure; outlet valve operating pin in piston is stopped by fixed crosspin and piston outlet valve is opened. Excess fluid in brake operating line flows through two holes in piston into the return line to reservoir. Brake valve also acts as automatic unloading valve to maintain constant pressure in brake operating line, regardless of thermal expansion or contraction of the fluid.

COLOR CODE: FLUID PRESSURE · FLUID PRESSURE FLOW · FLUID RETURN · FLUID RETURN FLOW

Figure 407—Operation of Brake Control Valve

CAUTION

> Keep the free end of the bleeder hose submerged in hydraulic fluid during the entire bleeding operation and until after the bleeder valve has been closed so that air will not be drawn into the hydraulic lines.

f. Apply toe pressure to the rudder-brake pedal. The pedal action should be "hard." If "spongy" action is noted, it will be necessary to check the brake hydraulic lines and connections for fluid leaks. Replace defective lines or connectors and again bleed the brake lines as instructed above.

g. Repeat the bleeding procedure, in accordance with preceding instructions, on the opposite wheel brake lines.

2. LOW-PRESSURE ADJUSTMENT.

a. Replace the bleeder hoses with 1000 psi gages on the bleeder fitting of each inboard brake. Obtain full system pressure of 875 psi and turn in low-pressure adjusting screw on the brake control valve until approximately 200 psi is indicated on the gage at the brake. Set the parking brakes to obtain the required 835 psi.

b. Release parking brake. Release the low pressure adjusting screws and replace the 1000 psi gages with 100 psi gages.

c. With full system pressure of 875 psi in the hydraulic system, turn in the low-pressure adjusting screw until 50 psi is indicated on the gage at the brake. Back off the screw until free. Approximately 7 psi static fluid pressure will be indicated on the gage at the brake.

d. Turn in low-pressure adjusting screw again until 50 psi is indicated on gage. Back off the low-pressure screw by quick half-turns, watching the gage indication at each half-turn. When the pressure gage indicates the 7 psi static pressure, back off the screw an additional half-turn and tighten the lock nut.

e. Repeat the low-pressure adjustment on the opposite wheel.

CAUTION

> Do not depress the rudder-brake pedals during the low-pressure adjustment or the 100 psi gages will be damaged.

3. HIGH-PRESSURE ADJUSTMENT.

a. Replace the 100 psi gages with 1000 psi gages. With one man in the pilots' compartment to apply the rudder-brake pedals, adjust each brake "tuning fork" lever.

b. Place the high-pressure adjusting clamp approximately in the center of its travel. Tighten set screw. Apply toe pressure to rudder-brake pedal until pedal hits stop. Observe the pressure indication at the gage. Readjust the clamp as necessary to obtain the required 650 ± 15 psi indication at the gage; move the clamp forward to increase the pressure or aft to decrease the pressure. The set screw must be tightened after each trial to insure accurate adjustment. When the correct adjustment is obtained tighten the set screw and safety with lock wire.

c. Repeat the adjustment of the high-pressure clamp on the opposite brake. With 800 psi in hydraulic system, set the parking brakes. Relieve the pressure in the remainder of the hydraulic system by operating the wing flaps. A pressure drop indication of 50 psi, but not below 400 psi minimum at the gages, is allowable.

d. Release the parking brake. Remove the pressure gages. Tighten all bleeder valve screws and safety with lock wire.

Note

> Whenever the low-pressure screw is adjusted, the high-pressure clamp must be readjusted.

4. BRAKE SHOE ADJUSTMENT.—To adjust the brake shoes, refer to paragraph *4.b.*(6)*(c)4,* this section.

5. BRAKE PEDAL ADJUSTMENT.—To adjust the rudder-brake pedals refer to figure 412.

(e) TESTS BEFORE INSTALLATION.—Refer to figure 409 for fluid leak tests of the brake control valve.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—Be sure all parts are clean of oil and grease before assembly. Refer to figure 408 and observe the following instructions:

a. Slide the piston into the nut and place the pin through the hole in the nut and the piston.

b. Install the spacer and packing rings in the valve housing.

c. Drop the piston, cup packing, and nut assembly into the valve housing and tighten the nut by turning the lower end of the piston with a wrench.

d. Install the packing nut. Do not tighten this nut excessively as it may cause distortion of the packing and prevent free operation of the valve piston.

e. Place the inlet valve operating pin in the piston. Install spacer on piston cup packing. Place spring on spacer.

f. Install gasket and cover assembly. Set the studs in white lead.

g. Set the link in the lower end of the piston and secure with a cotter.

h. With valve assembled apply 200 psi hydraulic pressure at the pressure port to seat inlet valve ball. Turn the piston at its lower end until the piston raises the pin and forces the inlet valve ball off its seat and fluid flows through the valve. Back off the piston until the flow stops. Back off the piston an additional one-eighth turn. Insert the fiber plug in the locking hole. Install locking screw, lock nut, washer, and cap nut.

Note

> Tighten the lock screw to 15 to 30 inch-pounds wrench torque so that the piston and nut will not back off when 35 inch-pounds

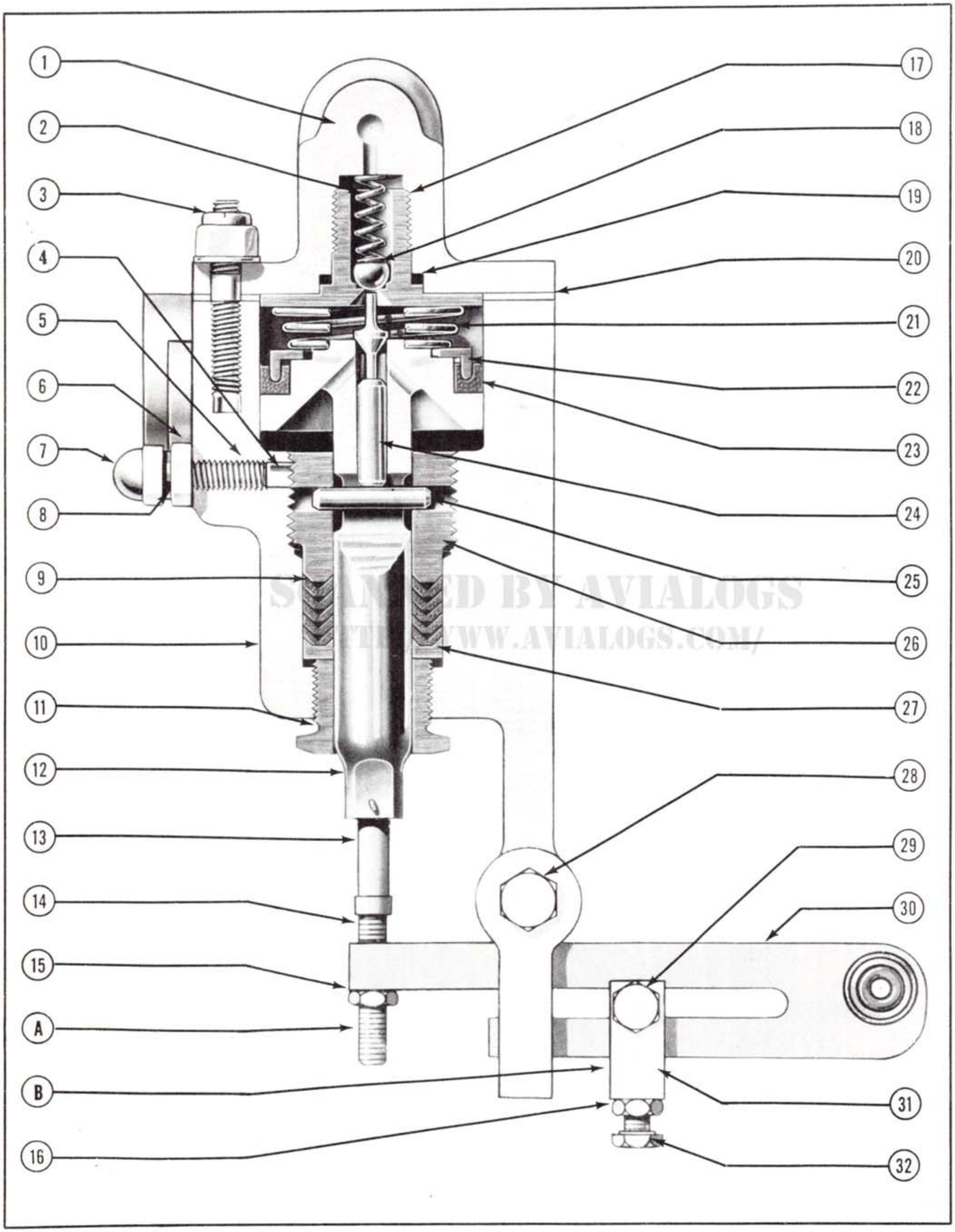

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
A
B
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32

Figure 408—Brake Control Valve Assembly

KEY TO FIGURE 408

(Douglas Dwg. Nos. 5007340-500 and 5143257)

Item	*Part No.*	*Part Name*	*No. Req*
1	4024868	Cover	1
2	1007336	Spring	2
3	1104799-2	Stud (Set in White Lead)	10
	AF365-428	Nut	10
	AN960-416	Washer	10
4	5007340-5 or 5143257-2	Plug 5/32 Dia x 1/2 Red Fiber	2
5	1007693	Screw	2
6	AN315-3R	Nut	2
7	10-32	Nickel Plated Brass Cap Nut	2
8	143908-006TC012-040	Washer	4
9	*5135865-4X-016	Packing	8
	**AN6225-12	Packing	8
10	*4007343	Housing	1
	**5203968	Housing	1
11	1007329	Nut	2
	AF995C40-4	Lock Wire	2
12	1024867	Piston	2
13	1007965	Link	2
	AN380-2-2	Cotter	2
14	1005307	Screw	2
15	AN316-5R	Nut	2
16	AN316-4R	Nut	2
17	1024864	Seat	2
18		1/4-inch Dia Bright Steel Ball	2
19	143908-016TC020-063	Washer	2
20	1007694	Gasket	1
21	1007337	Spring	2
22	1024866	Spacer	2
23	*1044344-G-104	Packing	2
	**AN-6226-52	Packing	2
24	1024865	Pin	2
25	1007332	Pin	2
26	1007331	Nut	2
27	1007330	Spacer	2
28	*1007328	Shaft	2
	*AF995C40-2	Lock Wire	2
	*1007327	Shaft (Assemble with Hole in Shaft Opposite Hole in Housing)	1
	**1143386	Bolt	1
	**AN960-716	Washer	1
	**AN310-7	Nut	1
	**AN380-3-4	Cotter	1
29	1119763	Bolt	2
	AC365-428	Nut	2
	AF995C40-6	Lock Wire	2
30	2007339	Lever Assembly	2
	Includes		
	AN200K3L	Bearing	2
	B364-0357	Atlas Compo Bushing (Press Fit)	2
31	1119747	Clamp	2
32	110242-4-5 AH	Bolt	2
A		Low-Pressure Adjustment	
B		High-Pressure Adjustment	

*Used on 5007340-500 Valve Assembly

**Used on 5143257 Valve Assembly

force is applied to the piston in the raised position. If the lock screw will not enter the valve body sufficiently at the required torque to permit proper installation and seal of the cap nut, the fiber plug may be shortened as necessary.

2. INSTALLATION.—To install the power brake control valve reverse the removal procedure as outlined in paragraph 13.*d.*(2)*(b)* preceding.

(g) MAJOR OVERHAUL.

1. Remove the power brake control valve as instructed in paragraph 13.*d.*(2)*(b),* and refer to figure 408 for disassembly of the valve.

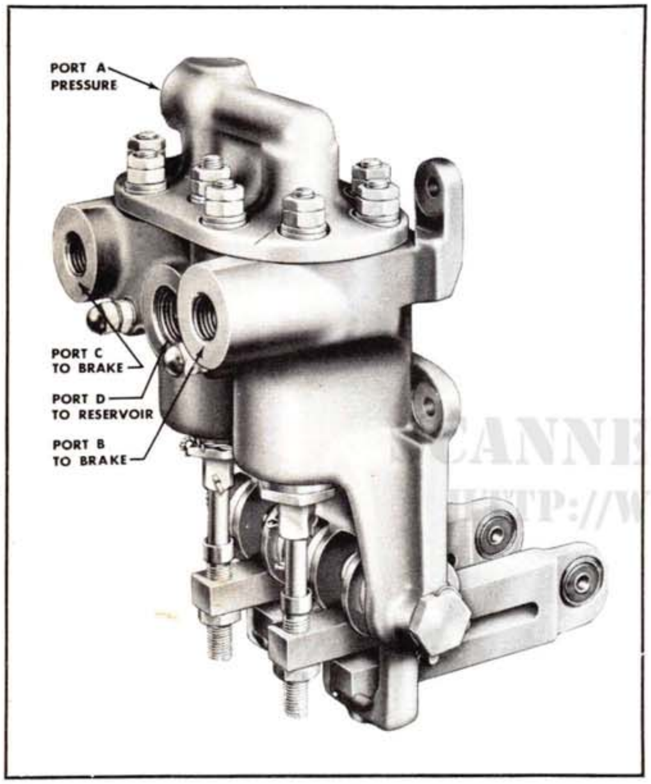


Figure 409—Brake Control Valve Test Connections

2. Refer to figure 411 for rework tolerances.

3. Carefully inspect all packing for defects and wear. Install new parts if necessary.

4. Inspect all parts for wear and replace with new parts if necessary.

5. When repairs have been completed, assemble the valve in accordance with preceding instructions. Refer to figure 409 for fluid leak tests of the brake control valve.

(3) BRAKE ACTUATING CYLINDER.

(a) DESCRIPTION.—The brake actuating cylinder is an integral part of the brake torque spider (figure 162). The actuating mechanism consists of two piston and cup assemblies in the cylinder. The connections between the actuating pistons and brake shoes are provided by two floating anchor caps. When toe pressure is applied to the rudder-brake pedals and hydraulic fluid flows through the brake control valve to the brake cylinder, the brake actuating pistons are forced outward, and in turn force the brake shoes against the brake drum to produce the braking action. When the rudder-brake pedals are released, the brake shoes are returned to the non-operating position by the return spring, the brake actuating pistons are forced inward by the brake shoes, and the excess fluid returns to the hydraulic reservoir through the brake operating line, brake control valve, and brake return line.

SCANNED BY AVIALOGS HTTP://WWW.AVIALOGS.COM/

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.—To remove the brake actuating cylinder refer to paragraph 4.*b.*(6)*(c)*2, this section.

2. DISASSEMBLY.—To disassemble the brake actuating cylinder refer to paragraph 4.*b.*(6)*(c)*2, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 4.*b.*(6)*(c)*3, this section.

(d) TESTS BEFORE INSTALLATION.—Refer to paragraph 4.*b.*(6)*(c)*3, this section.

KEY TO FIGURE 409

(Douglas Dwg. Nos. 5007340-500 and 5143257)

TEST PROCEDURE

Test Port	*Ports Plugged*	*Test Pressure*	*Piston Position*	*Maximum Leakage*	*Flow GPM*	*Remarks*
A	None	1200 psi	Free	1 drop per hour past each ball. No other leakage	———	May be tested before head is assembled on housing
A	B and C	1000 psi	Up	1 drop per hour past packing. 1 drop per hour past valve seat	———	
A	None	80 psi	Up	—— ——	1.5 at B 1.5 at C	
B	A and C	10 psi	Free	—— ——	1.5 at D	
C	A and B	10 psi	Free	—— ——	1.5 at D	
D	A,B, and C	100 psi	Free	2 drops in 12 hours past packing	———	

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the brake actuating cylinder refer to paragraph 4.*b*.(6)*(c)*5, this section.

2. INSTALLATION.—To install the brake actuating cylinder refer to paragraph 4.*b*.(6)*(c)*5, this section.

(f) MAJOR OVERHAUL.—For major overhaul instructions refer to paragraph 4.*b*.(6)*(c)*6, this section.

(4) CHECK VALVE.

(a) DESCRIPTION.—A check valve (figure 385) is installed in the pressure port of the brake control valve to prevent back flow from the brake valve in the event of a failure in the brake pressure line.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. The check valve may be reached by opening the hinged upper section of the nose section of the fuselage.

b. Disconnect and cap the hydraulic line leading to the check valve.

c. Unscrew the check valve from the brake control valve and remove the check valve from the airplane.

2. DISASSEMBLY.—The check valve may be disassembled by unscrewing the end fitting.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the check valve is damaged or is not functioning properly, replace it with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.—Refer to figure 385 for fluid leak tests of the check valve.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.

a. Be sure all parts of the check valve are clean before assembly.

b. Install the ball or poppet in the valve body. Place the spring in the valve and install the gasket and end fitting.

2. INSTALLATION.—To install the check valve reverse the removal procedure.

(f) MAJOR OVERHAUL.—For major overhaul

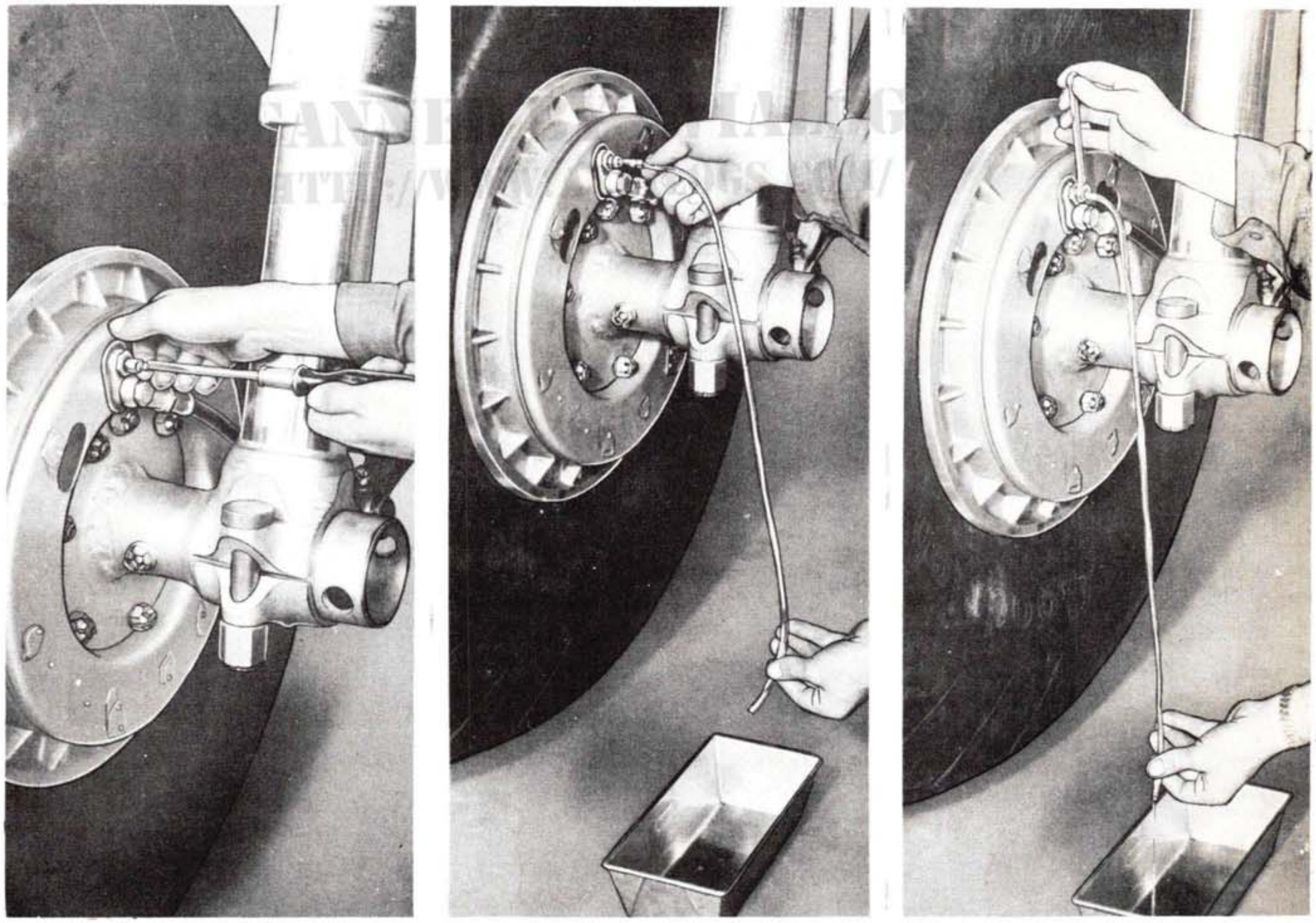


Figure 410—Bleeding the Brake Hydraulic System

Steps in bleeding the brake hydraulic system: first, remove bleeder valve cap screw; second, attach bleeder hose; third, open bleeder valve.

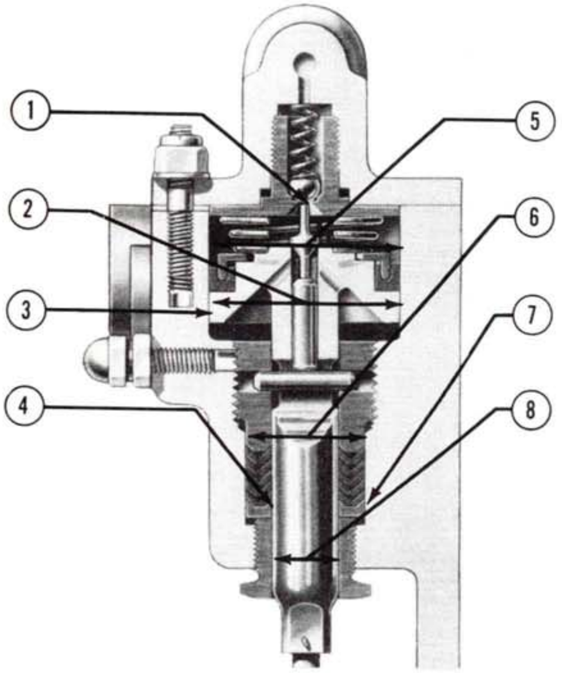


Figure 411—Rework Tolerances of Brake Control Valve

1. End of pin must be square.
2. Manufacturing dimension 1.4995 to 1.5015 ID.
3. If diametral clearance between piston and body exceeds .010, rework to .002 to .007 clearance by replacing piston.
4. If diametral clearance between spacer and piston exceeds .020, rework to .007 to .015 clearance by replacing spacer and nut.
5. Manufacturing dimension 1.497 to 1.494 OD
6. Manufacturing dimension 1.002 to 1.000 ID
7. If diametral clearance between spacer and body exceeds .020, rework to .005 to .012 by replacing spacer.
8. Manufacturing dimension .498 to .495 OD

Note

Cylinders may be honed to a maximum of .020 oversize.

instructions for the check valve refer to paragraph 13.*b.*(12)*(f)*.

(5) BRAKE SELF-SEALING COUPLINGS.

(a) DESCRIPTION.—On C-47B and late C-47A airplanes, self-sealing couplings are installed to connect the brake actuating cylinders to the flexible hoses leading to the brakes. These couplings make it possible to disconnect and connect the hoses at the brakes without either the loss of hydraulic fluid or introduction of air into the brake hydraulic lines. The coupling consists of two parts connected by a union nut. Each coupling half contains a spring-operated valve. Unscrewing of the union nut automatically closes the valves and tightening of the union nut opens the valves. No fluid leakage occurs when the coupling is connected or disconnected. The coupling is attached to the brake cylinder port with a hollow bolt, and sealed with two soft aluminum or copper gaskets. The hollow bolt is locked with a swivel coupling bolt locking plate.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

b. Remove the swivel coupling bolt locking plate, disconnect the flexible hose from the coupling and plug the exposed end of the hose.

c. Remove the bolt that attaches the coupling to the brake cylinder port. Plug the exposed hole in the brake cylinder port.

2. DISASSEMBLY.—Disassembly of the self-sealing coupling should not be attempted in the field since few repairs can be made to the part. One half of the coupling can be disassembled by unscrewing the mounting fitting. The other half of the coupling cannot be disassembled.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Other than replacement of the seal on one half of the coupling, do not attempt repair of the self-sealing coupling. If the coupling is damaged or is not functioning properly, it should be replaced with a new or serviceable part.

(d) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the one half of the coupling, reverse the disassembly procedure.

2. INSTALLATION.—To install the self-sealing coupling reverse the removal procedure.

(6) PARKING BRAKE MECHANISM.

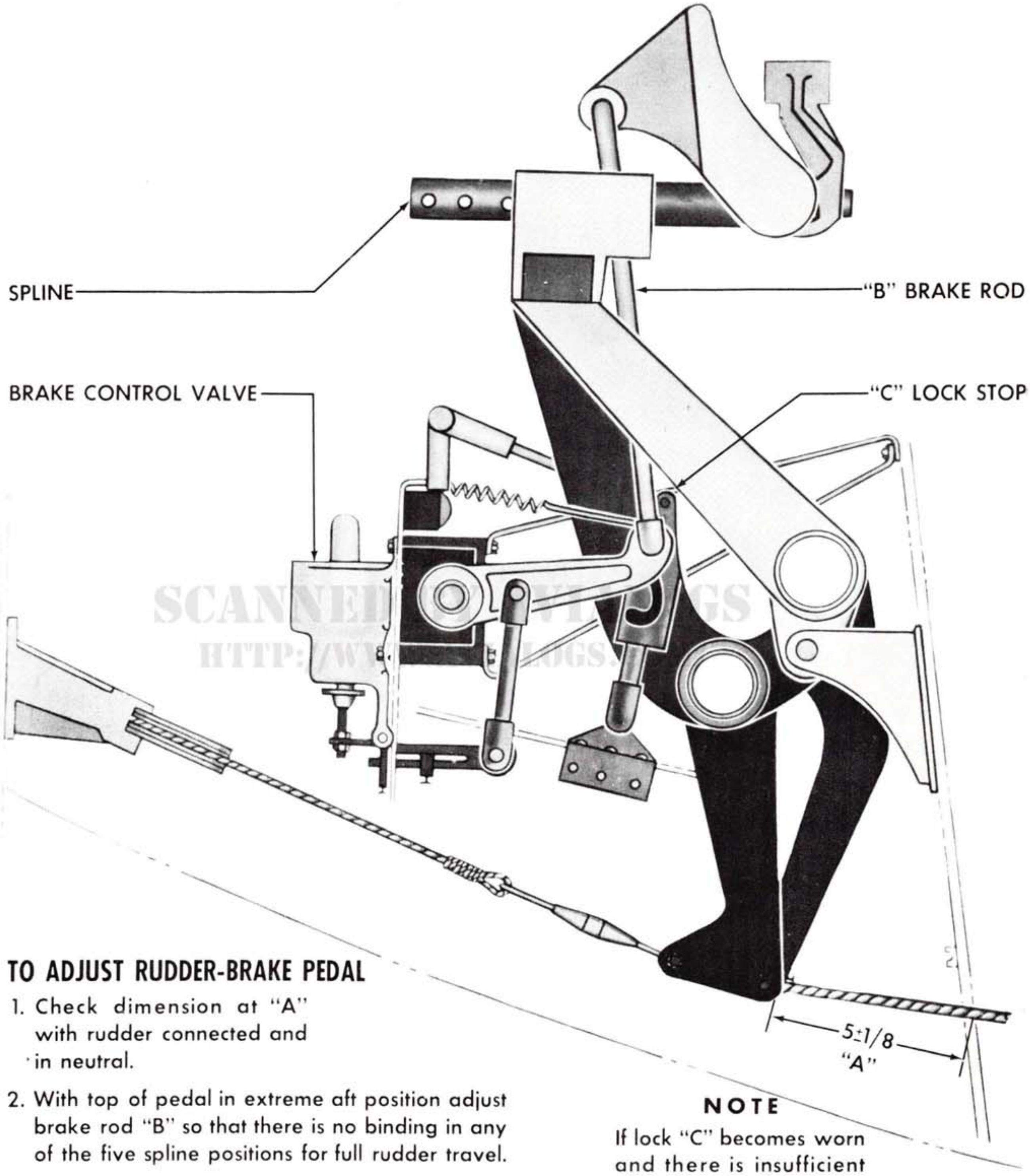
(See figure 413.)

(a) DESCRIPTION.—Setting the main wheel brakes for parking is accomplished by means of the manually operated plunger control mounted on the lower portion of the control pedestal. (See figure 414.) The parking brake mechanism is a locking device that holds the rudder-brake pedals in the depressed or operating position. To set the parking brake, depress the rudder-brake pedals fully and pull out the parking brake control knob. Release the rudder-brake pedals before releasing the parking brake control knob. The hydraulic system pressure gage should indicate a minimum of 500 psi for satisfactory parking brake operation. DO NOT SET THE PARKING BRAKE IN FLIGHT. To release the parking brake, apply toe pressure on the rudder-brake pedals. It is not possible to lock or unlock the brakes on each wheel separately; the brakes on both wheels are set simultaneously.

(b) REMOVAL.—Refer to figure 413 for removal procedure for the parking brake mechanism.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. The parking brake mechanism does not require any maintenance other than periodic inspection of parts for security and evidence of excessive wear. Replace all worn parts with new parts.



TO ADJUST RUDDER-BRAKE PEDAL

1. Check dimension at "A" with rudder connected and in neutral.
2. With top of pedal in extreme aft position adjust brake rod "B" so that there is no binding in any of the five spline positions for full rudder travel.
3. Adjust the brake control valve as noted in the text. No other adjustments are necessary. Do not change setting of torque stops.

NOTE

If lock "C" becomes worn and there is insufficient brake pressure with parking brake "ON" replace the lock stop.

Figure 412—Rudder-Brake Pedal Adjustment Procedure

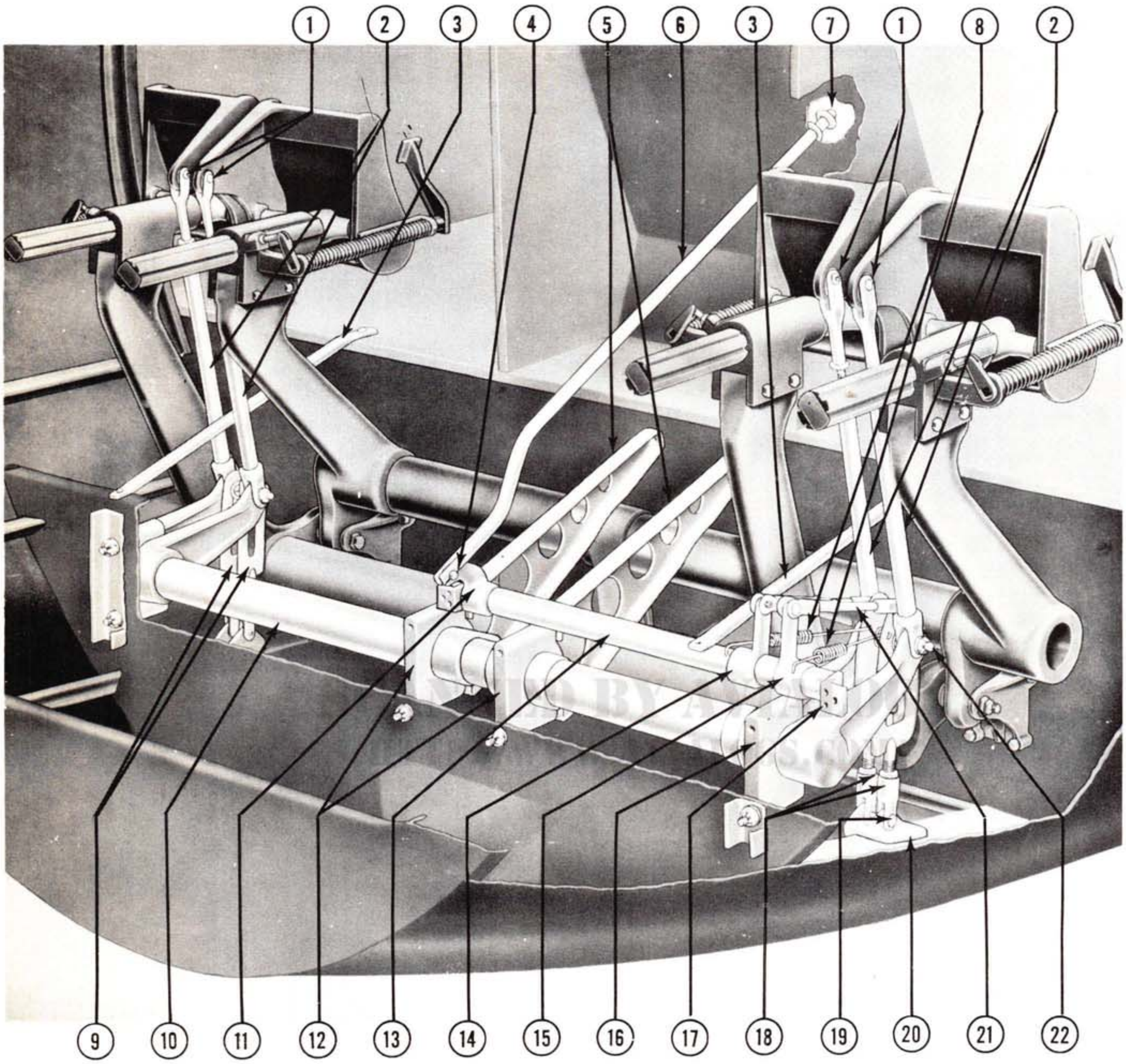

1
2
3
4
5
6
3
7
1
8
2
9
10
11
12
13
14
15
16
17
18
19
20
21
22

Figure 413—Parking Brake Mechanism

(Douglas Dwg. No. 5110547)

Item	*Part No.*	*Part Name*	*No. Req*
1	AN3-10	Bolt	4
	AN310-3	Nut	4
	AN380-2-2	Cotter	4
2	1118475	Brake Rod	4
	Consists of:		
	1005306	Clevis	1
	1118475-2	Clevis (Make from AN486-3)	1
	AN316-4R	Nut	1
	1118475-1	Tube	1
3	1118289	Support	2
	Attached by:		
	AN515-8-6	Screw	4
	AF366DF-8-32	Nut Plate	4

KEY TO FIGURE 413—Continued

Item	*Part No.*	*Part Name*	*No. Req*
4	AN23-9	Bolt	1
	AN320-3	Nut	1
	AN380-2-2	Cotter	1
5	4118318	Brace	2
	AF515-8-7	Screw	2
	AF365D832	Nut	2
6	1118285	Rod	2
7	1118286	Handle	1
	1/4 x 28	Acorn Nut	1
8	1118476	Spring	2
9	2118309	Stop Assembly-RH	2
	Consists of:		
	2118309-2	Plate	1
	1005593	Clevis	1
	AN316-5R	Nut	1
	Attached by:		
	AN393-41	Flathead Pin	1
	AN380-2-2	Cotter	1
10	5116804	Brake Torque Tube Assembly	1
11	1118288	Arm	1
	Attached by:		
	AN23-21	Bolt—Clevis	1
	AN320-3	Nut	1
	AN380-2-2	Cotter	1
12	2118305	Center Bearing	2
	Attached by:		
	AN3-30	Bolt	4
	AN310-3	Nut	4
	AN380-2-2	Cotter	4
13	3118298	Shaft Assembly	1
	Consists of:		
	3118298-1	Tube	1
	AN200-K3	Ball Bearing	2
14	1118284-1	RH Arm	1
	Attached by:		
	AN23-21	Bolt—Clevis	1
	AN320-3	Nut	1
	AN380-2-2	Cotter	1
15	1118284	LH Arm	1
	Attached by:		
	AN23-21	Bolt—Clevis	1
	AN320-3	Nut	1
	AN380-2-2	Cotter	1
16	1118276	Outer Bearing	2
	Attached by:		
	AN3-23	Bolt	4
	AN310-3	Nut	4
	AN380-2-2	Cotter	4
17	1118287	Bearing	2
	Attached by:		
	AN3-4A	Bolt	6
	AN960-D10	Washers	6
	AF365-1032	Nut	6
18	2118313	Stop Assembly—LH	2
	Consists of:		
	2118313-2	Plate	1
	1005593	Clevis	1
	AN316-5R	Nut	1

KEY TO FIGURE 413—Continued

Item	*Part No.*	*Part Name*	*No. Req*
19	AN393-41	Flathead Pin	2
	AN380-2-2	Cotter	2
20	2118308	Support—LH	1
	2118308-1	Support—RH	1
21	1118285	Rod Assembly	2
	Consists of:		
	1118285-1	Rod	1
	AN486-4	Clevis	1
	AN316-4R	Nut	1
	Attached by:		
	AN23-10	Bolt	2
	AN393-9	Pin	2
	AN320-3	Nut	2
	AN380-2-2	Cotter	2
22	AN24-24	Bolt	2
	AN24-22	Bolt	2
	AF960-416	Washer	2
	AN320-4	Nut	4
	AN380-2-2	Cotter	4
	1139420	Bushing	4
	143908-008S028-064	Washer	*18
	143908-008S028-032	Washer	*4
	143908-008S016-064	Washer	*2

*Use as required

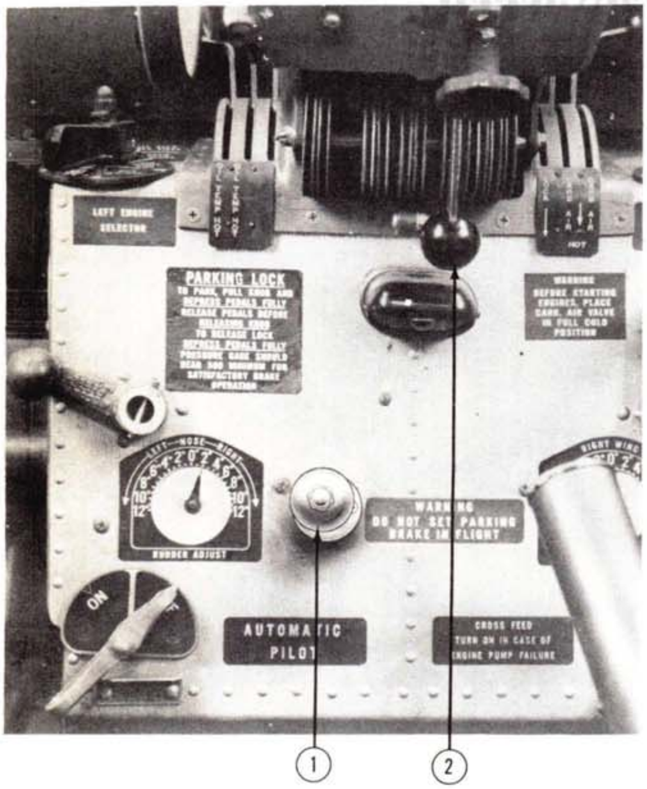

LEFT ENGINE SELECTOR
PARKING LOCK
TO PARK, PULL KNOB AND DEPRESS PEDALS FULLY RELEASE PEDALS BEFORE RELEASING KNOB
TO RELEASE LOCK DEPRESS PEDALS FULLY PRESSURE GAGE SHOULD READ 500 MINIMUM FOR SATISFACTORY BRAKE OPERATION
WARNING BEFORE STARTING ENGINES, PLACE CARB. AIR VALVE IN FULL COLD POSITION
LEFT—NOSE—RIGHT
RUDDER ADJUST
WARNING DO NOT SET PARKING BRAKE IN FLIGHT
ON
AUTOMATIC PILOT
CROSS FEED TURN ON IN CASE OF ENGINE PUMP FAILURE
1
2

Figure 414—Parking Brake Control Installed

1. Parking Brake Control Knob
2. Lever—Tail Wheel Lock

(d) ADJUSTMENTS.—Refer to figure 412 for adjustments of the rudder-brake pedals and parking brake mechanism.

(e) INSTALLATION.—Refer to figure 413 to install the parking brake mechanism.

e. COWL FLAP HYDRAULIC SYSTEM.
(See figure 415.)

(1) GENERAL. — Hydraulically actuated cowl flaps are provided on the trailing edge of each engine antidrag ring to control flow of air over the engines. The cowl flaps for each engine are operated by hydraulic control valves located on the right side of the pilots' compartment (figure 423). The cowl flaps are actuated through a series of rods and levers by the cowl flap actuating cylinder located on the lower inboard segment of the engine antidrag ring. For further information about the cowl flap mechanism refer to paragraph 5.*e,* this section. To open the cowl flaps, the control valve handle is moved to the "OPEN" position. Fluid under pressure then is directed through the cowl flaps OPEN line to the proper end of the actuating cylinder to open the flaps, and the returning fluid from the actuating cylinder flows through the cowl flaps CLOSE line to the control valve and into the return line to the reservoir. When the control valve handle is moved to the "CLOSE" position, the fluid flow is reversed and the actuating cylinder and rods close the cowl flaps. To lock the cowl flaps in a desired position, the control valve handle is moved to the "OFF" position after the flaps have reached the desired position. In the "OFF"

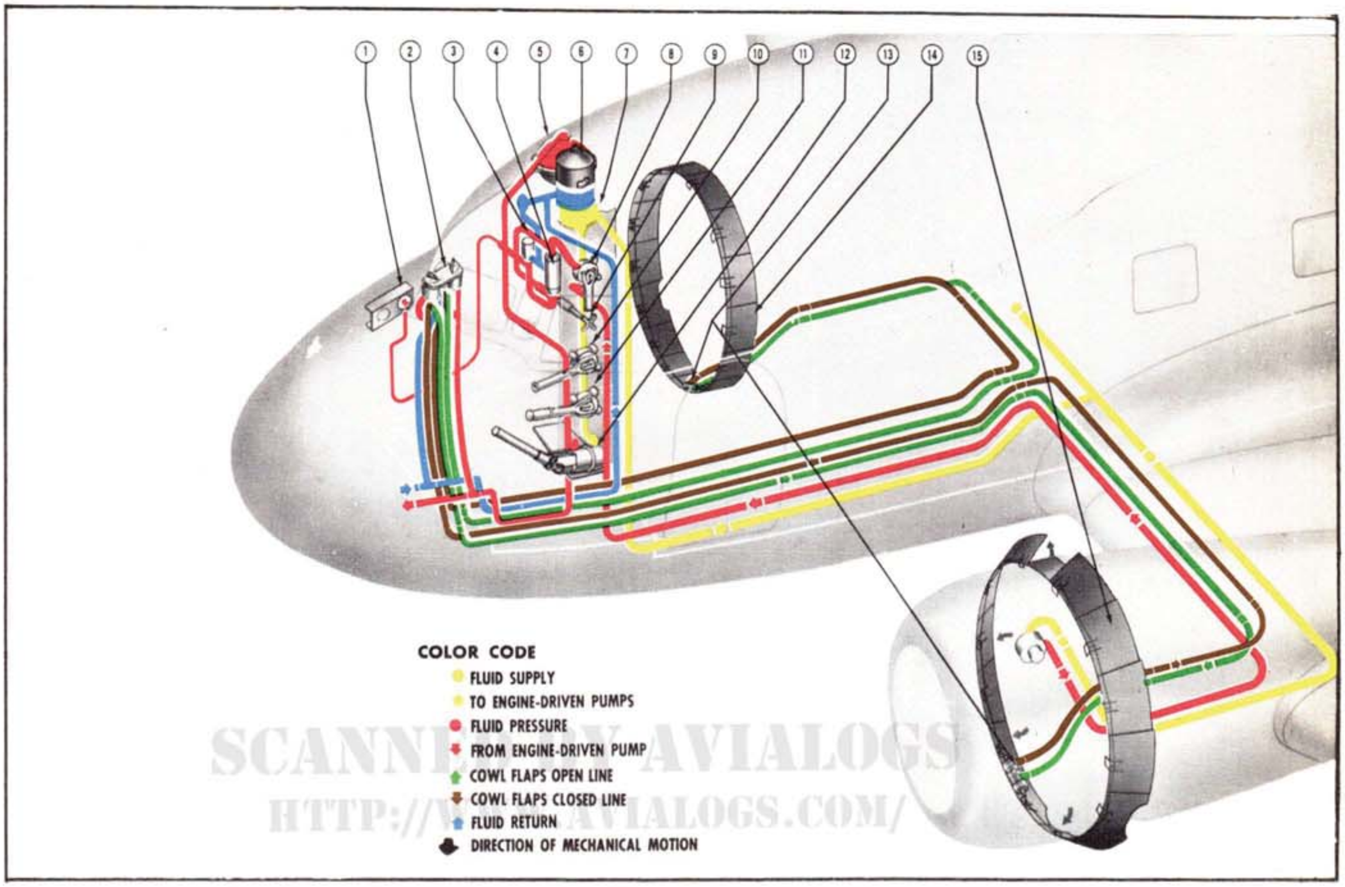

①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
⑫
⑬
⑭
⑮
COLOR CODE
● FLUID SUPPLY
● TO ENGINE-DRIVEN PUMPS
● FLUID PRESSURE
● FROM ENGINE-DRIVEN PUMP
● COWL FLAPS OPEN LINE
● COWL FLAPS CLOSED LINE
● FLUID RETURN
● DIRECTION OF MECHANICAL MOTION

Figure 415—Cowl Flap Hydraulic System

(Douglas Dwg. Nos. 5110553, 5141943, 5110513, 5141942, 5110578, 5113759, and 5141800)

1. Hydraulic System Pressure Gage
2. Cowl Flap Control Valve Assembly (See figures 421 and 423)
3. Hydraulic System Pressure Relief Valve (See figure 375)
4. Hydraulic System Pressure Regulator (See figure 368)
5. Hydraulic System Pressure Accumulator (See figure 367)
6. Hydraulic System Fluid Reservoir (See figure 374)
7. Hydraulic Control Panel (See figure 361)
8. Engine-Driven Hydraulic Pump Selector Valve (See figure 366)
9. Hand Pump to Pressure Accumulator Shut-Off Valve (See figure 383)
10. Wing Flap Control Valve (See figure 390)
11. Landing-Gear Control Valve (See figure 390)
12. Hydraulic Hand Pump (See figure 376)
13. Cowl Flap Actuating Cylinders (See figures 416, 417, and 418)
14. Cowl Flaps (Closed)
15. Cowl Flaps (Open)

Note

For tubing and fittings information refer to figure 636, section VIII.

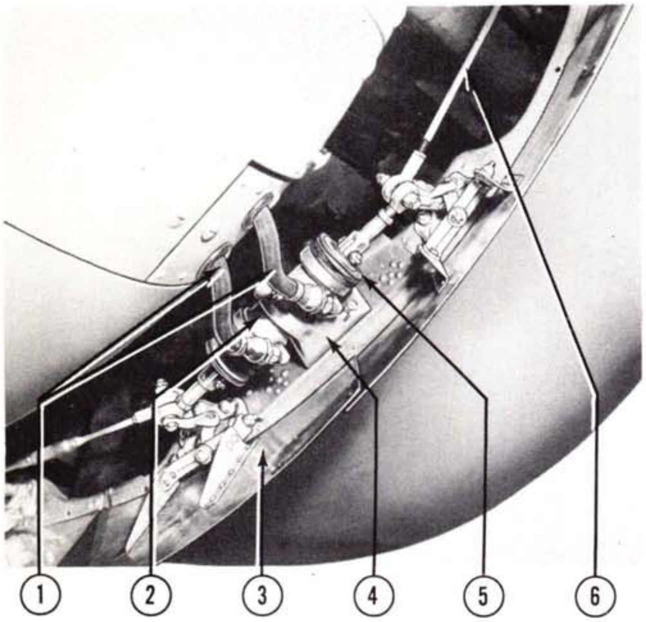


Figure 416—Cowl Flap Actuating Cylinder Installed

1. Flexible Hoses to Actuating Cylinder
2. Cowl Flap Actuating Cylinder
3. Cowl Flaps (Open)
4. Actuating Cylinder Mounting Bracket
5. Dust Excluder (Some Airplanes)
6. Cowl Flap Operating Rod

position the ports of the control valve connected to the operating lines are closed and fluid cannot flow either to or from the actuating cylinder, locking the cylinder piston in place and preventing the flaps from moving. When the control valve handle is moved to the "TRAIL" position, both operating ports to the actuating cylinder are connected to the return port, allowing the actuating cylinder piston to move in either direction depending on the balance of the air loads on the cowl flaps. The control valve contains an integral pressure relief valve that allows fluid to flow into the return line when hydraulic pressure in the cowl flap system increases to 1150 ± 50 psi because of either thermal expansion of the hydraulic fluid or excessive air loads on the cowl flaps.

(2) COWL FLAP CONTROL VALVE.
(See figures 421 and 422.)

(a) DESCRIPTION.—The cowl flap control valve assembly consists of two four-way valves bolted to a bracket which is attached to the right side of the pilots' compartment. Two types of valves have been used and the valve and bracket assemblies are interchangeable. One valve employs spring-loaded steel poppets while the other utilizes spring-loaded steel balls to close the valve ports. The poppets or balls are opened by steel pins. The pins are depressed in the proper combination by a cam rotor in the head of the valve. The cam rotor is operated by the valve handle. A pressure-relief valve is incorporated in the valve to allow excess fluid to flow to the return line when pressure in the cowl flap hydraulic system exceeds 1150 ± 50 psi. The Adel valve assembly used on some airplanes is similar to the non-ram carburetor air filter control valve (figure 439).

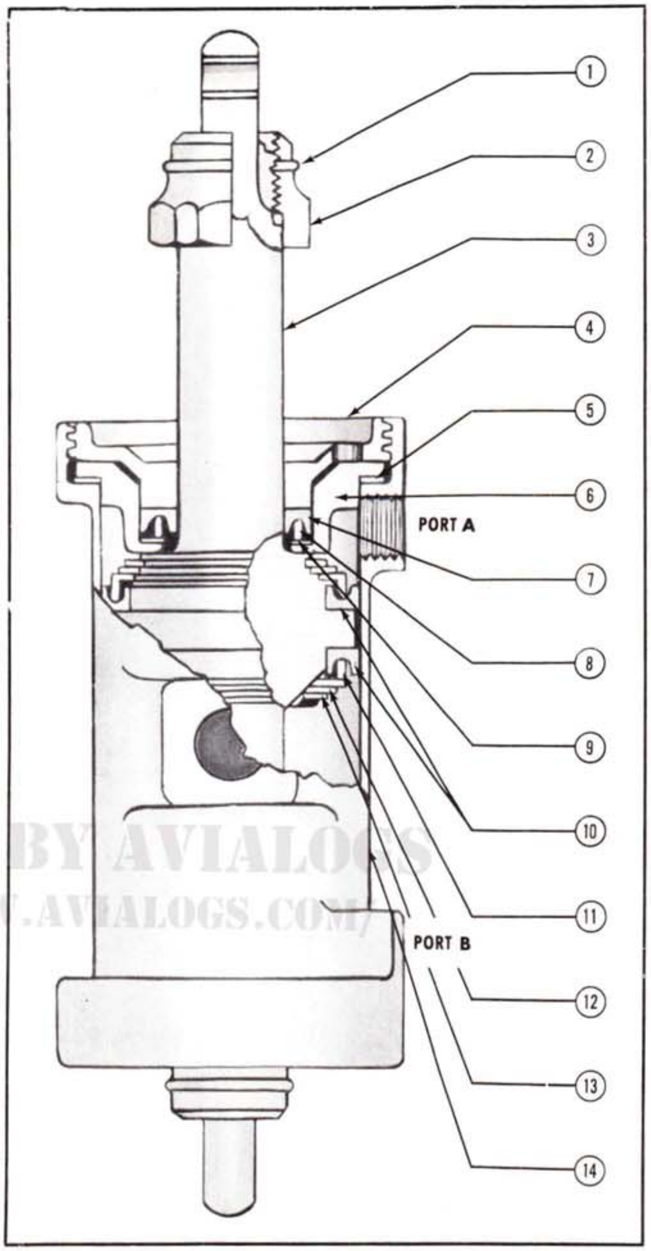


Figure 417—Cowl Flap Actuating Cylinder Assembly

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

b. Unsnap the soundproofing to uncover the hydraulic lines leading to the valve assembly (figure 423).

c. Disconnect and cap the lines leading to the valve assembly.

KEY TO FIGURE 417

(Douglas Drawing No. 2116312)

TEST PROCEDURE

Test Port	*Ports Plugged*	*Test Pressure*	*Max. Leakage*
A	None	1200 psi	1 drop per hour past piston. 2 drops in 12 hours past piston rod packing
B	None	1200 psi	1 drop per hour past piston. 2 drops in 12 hours past piston rod packing

Item	*Part No.*	*Part Name*	*No. Req*
1	1116303	Snap Ring	2
2	1116309	Nut	2
3	2116310	Piston	1
	Includes:		
	1119098	Bushing	2
4	1116307	End	2
5	143908-.116F-124-.064	Gasket	2
6	1116308	Collar	2
7	1049003-H-.020	Packing Cup	2
8	1116305	Ring	2
9	143908-.022D100-.018	Washer	2
	143908-.022D100-.029	Washer (Use as Necessary Behind 1116305 Ring to Obtain .000-.017 Clearance Between Ring and Cup	2
10	1044344-G-104	Packing Cup	2
11	1116304	Ring	2
12	143908-102D111-.022	Washer (Use as Necessary Behind 1116304 Ring to Obtain .000 to .024 Clearance Between Ring and Cup	2
13	1116306	Snap Ring	2
14	2116311	Cylinder	1

d. Remove the bolts that attach the bracket to the fuselage; remove the valve and bracket assembly from the airplane.

2. DISASSEMBLY.—Do not attempt to disassemble this valve in the field. When the valve is disassembled, refer to figures 422 and 439, and observe the following precautions:

a. Remove the valves from the mounting bracket.

b. The top cover is under spring pressure. Remove with caution.

c. Valve must be in the upright position with the face plate up during disassembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the cowl flap control valve is damaged or is not functioning properly, replace it with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.—Refer to figures 421 and 422 for fluid leak tests of the cowl flap control valve.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the cowl flap control valve refer to figures 422 and 439.

2. INSTALLATION.—To install the cowl flap control valve reverse the removal procedure.

(f) MAJOR OVERHAUL.

1. Remove and disassemble the valve in accordance with preceding instructions.

2. Check all plungers and poppets or balls for wear, pitting, and scoring. Make necessary replacements with new parts.

3. Poppets that are only slightly worn may be lapped to a true seat with extra-fine grinding compound. Insert a tube or piece of soft wood into the poppet to hold the poppet while lapping.

4. Balls may be lapped to seat as instructed in paragraph 13.*b*.(12)*(f)*. Adjust the ball clearance to .005 to .006 inches by grinding ends of plungers in all ports.

5. Check all seals and gaskets for evidence of deterioration and install new parts if necessary.

6. Check springs for damage and make necessary replacements.

7. Assemble the valve and check for fluid leakage as instructed in figures 421 and 422.

(3) COWL FLAP ACTUATING CYLINDER.
(See figures 417 and 418.)

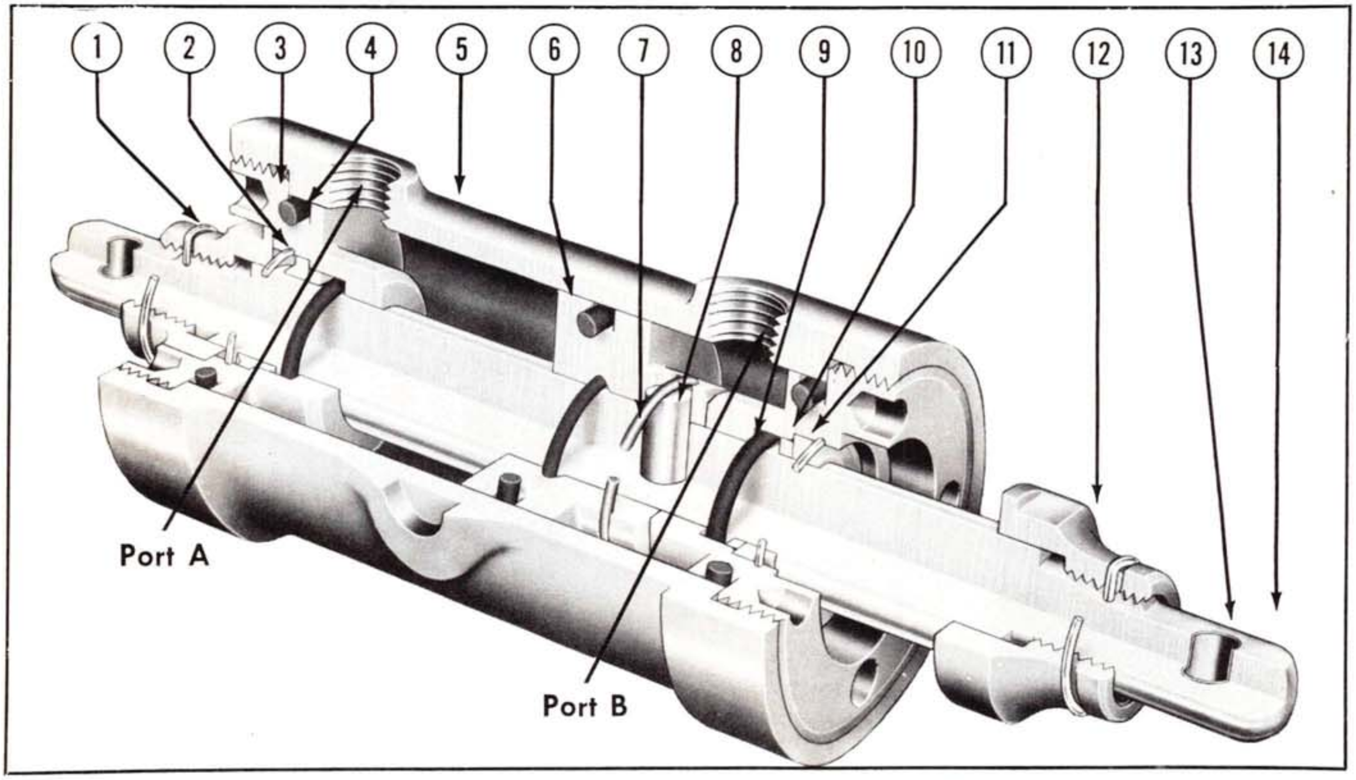


Figure 418—Cowl Flap Actuating Cylinder Assembly

1. Lock Ring
2. Retainer Ring
3. Cylinder End
4. AN6227-23 Packing (3 req)
5. Cylinder Barrel
6. Piston Head
7. Retainer Ring
8. Piston Pin
9. AN6227-12 Packing (3 req)
10. Spacer Ring
11. AN6231-3 Wiper (2 req)
12. Adjusting Nut
13. Piston Rod Bushing
14. Piston Rod

TEST PROCEDURE

Test Port	*Ports Plugged*	*Test Pressure*	*Max. Leakage*
A	None	1200 psi	1 drop per hour past piston. 2 drops in 12 hours past piston rod packing
B	None	1200 psi	1 drop per hour past piston. 2 drops in 12 hours past piston rod packing

(a) DESCRIPTION.—The cowl flap actuating cylinder, mounted in a bracket on the lower inboard segment of the engine antidrag ring (figure 416), consists of a cylinder that houses the double-acting reciprocating piston. Both ends of the piston assembly connect to the cowl flap rod and lever linkage, and the movement of the piston assembly actuates the cowl flap operating mechanism. Flexible hoses lead to the cowl flap actuating cylinder and dust excluders are installed on some cylinders to protect the exposed piston ends from dust and dirt. Two types of cowl flap actuating cylinders have been installed on the airplane. The two cylinders are virtually identical in external appearance and are interchangeable. The operation and function of the two cylinders are identical. The actuating cylinders on earlier airplanes have steel cylinders and incorporate packing cups. The cylinders on later airplanes have dural cylinders and incorporate "O" ring packings and a bronze wiper ring. The differences in the two cylinders may be seen by comparing figure 417 and figure 418. Complete information about the cowl flap mechanism is contained in paragraph 5.*e,* this section.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Open the cowl flaps fully.

b. Relieve the hydraulic system pressure by

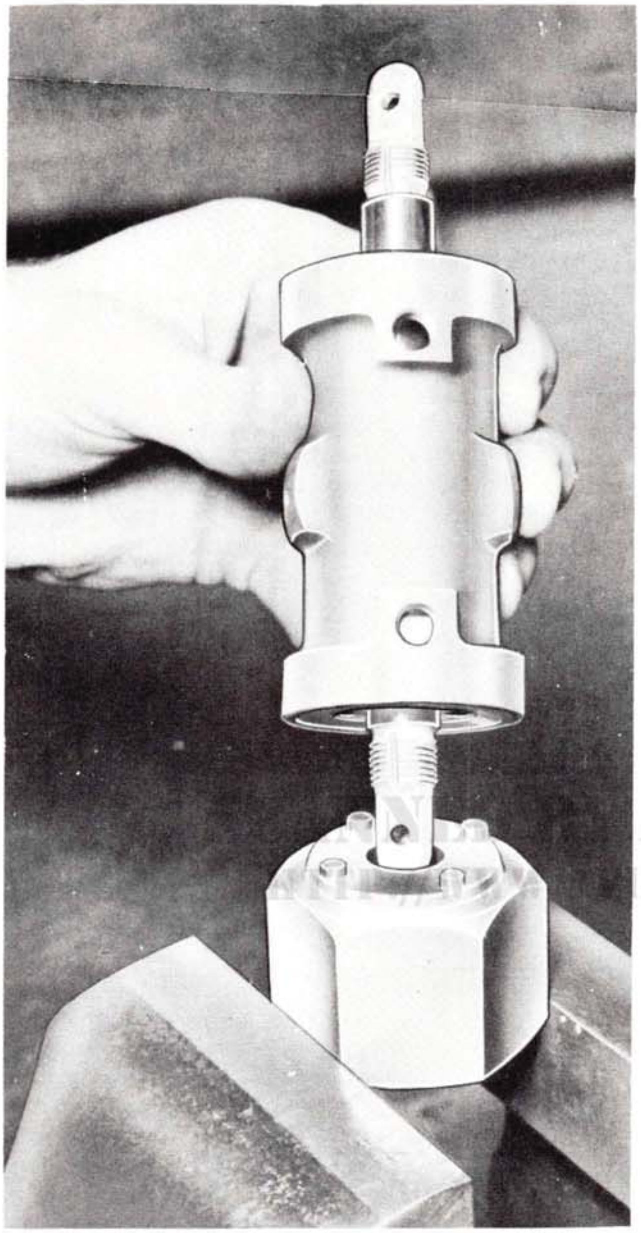


Figure 419—Use of Cowl Flap Actuating Cylinder End Nut Wrench (Service Tool No. K20401)

KEY TO FIGURE 420

(Douglas Dwg. No. 2116312)

1. Manufacturing dimension .620 to .622 OD
2. Manufacturing dimension .6255 to 6245 ID
3. If diametral clearance between end and rod exceeds .010, rework to .0055 to .0025 clearance by replacing end or by chrome plating piston.
4. If diametral clearance between piston and cylinder exceeds .015, rework to .011 to .005 clearance by chrome plating piston or replacing cylinder.
5. Manufacturing dimension 1.498 to 1.495 OD
6. Manufacturing dimension 1.506 to 1.503 ID

Note

Because of stress requirements do not have the cylinder larger than 1.525. Do not grind pistons more than .020 undersize. Pistons may be hard chrome plated a maximum of .020 on a diameter.

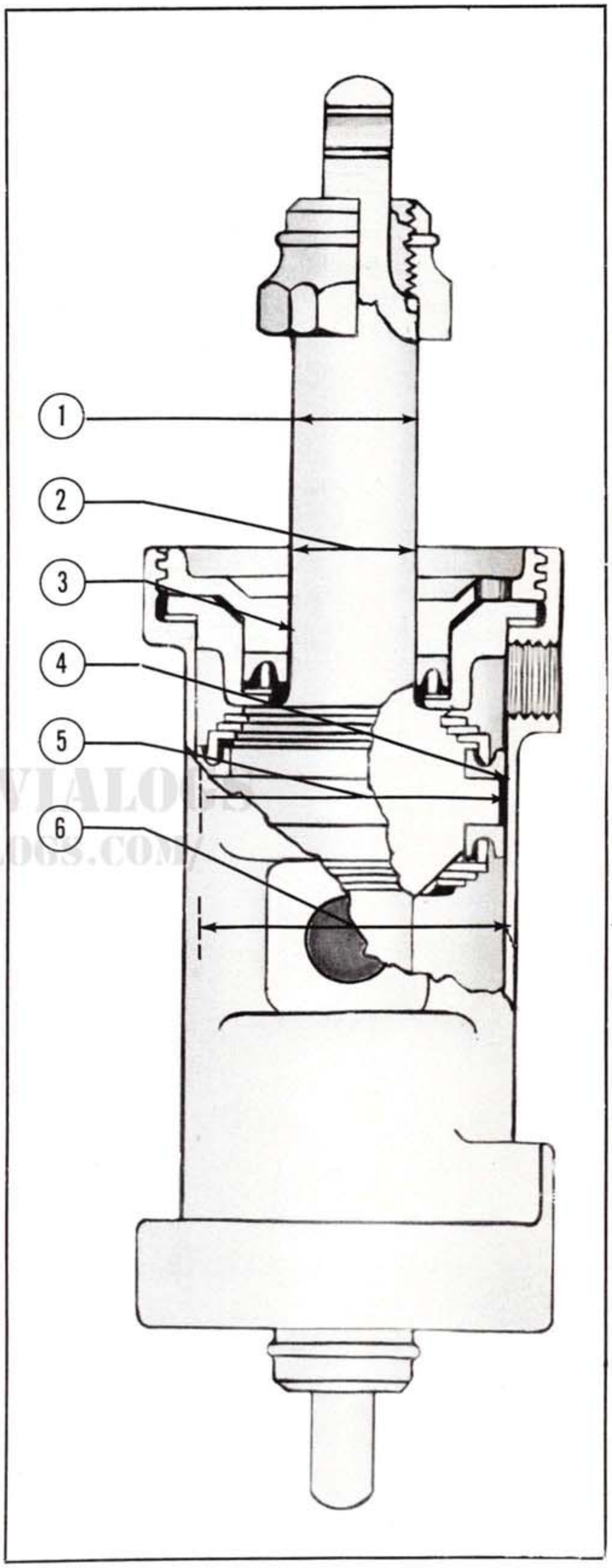


Figure 420—Rework Tolerances of Cowl Flap Actuating Cylinder

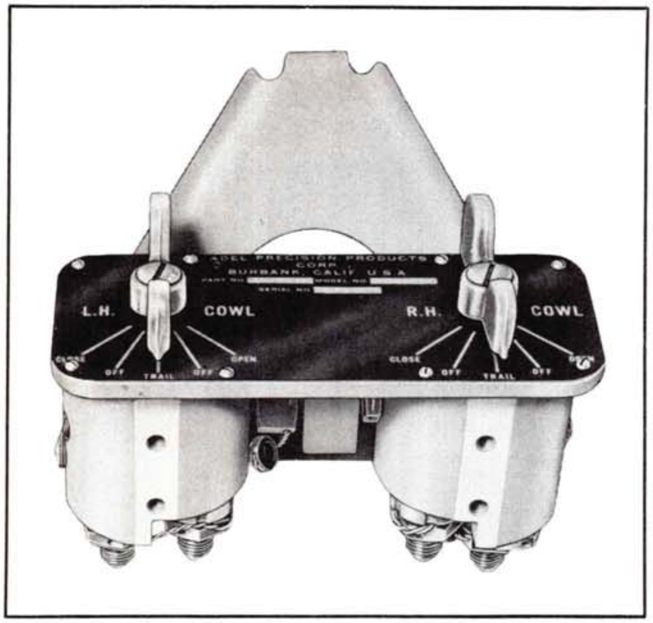


Figure 421—Cowl Flap Control Valve and Bracket Assembly

operating the wing flaps until the hydraulic system pressure gage indicates "zero."

c. Disconnect the cowl flap tie rods from each end of the actuating cylinder piston rods.

d. Remove the dust excluders, if installed, from each end of the actuating cylinder.

e. Disconnect and cap the hydraulic hoses leading to the actuating cylinder; remove the two elbows from the cylinder.

f. Remove the bolts that attach the cylinder to the support and remove the cylinder from the airplane.

2. DISASSEMBLY.—Disassembly of the cowl flap actuating cylinder should not be attempted in the field. If disassembly is undertaken refer to figures 417 and 418. Unscrew the end of the actuating cylinder by using service tool No. K20401 (figure 419) on the end and turning the cylinder with a strap wrench. Do not clamp the cylinder barrel in a vise or the cylinder walls will be distorted or damaged. Refer to figure 94 to fabricate the cowl flap cylinder end wrench.

KEY TO FIGURE 421

(Adel Precision Products Corp. No. D9726)

TEST PROCEDURE

Test Port	*Ports Plugged*	*Handle Position*	*Test Pressure*	*Max. Leakage*
Pressure	None	Off	1175 psi	Relief valve must relieve pressure
Open	Pressure	Open	1200 psi	None—External 10 drops per hour—internal
Close	Pressure	Close	1200 psi	None—External 10 drops per hour—internal
Pressure	All plugged	Any position	1000 psi	None—External 10 drops per hour—internal
Return	Open and close	Open to close both ways	125 psi	None—External 10 drops per hour—internal

KEY TO FIGURE 422

(Douglas Dwg. No. 5143815 and 4143736)

TEST PROCEDURE

Test Port	*Ports Plugged*	*Handle Position*	*Test Pressure*	*Max. Leakage*
Pressure	None	Off	1500 psi	None—External 10 drops per hour—internal
Pressure	Open	Open	1000 psi	None—External 10 drops per hour—internal
Pressure	Close	Close	1000 psi	None—External 10 drops per hour—internal
Return	Open, close and pressure	Any Position	125 psi	None—External 1 drop per hour—internal

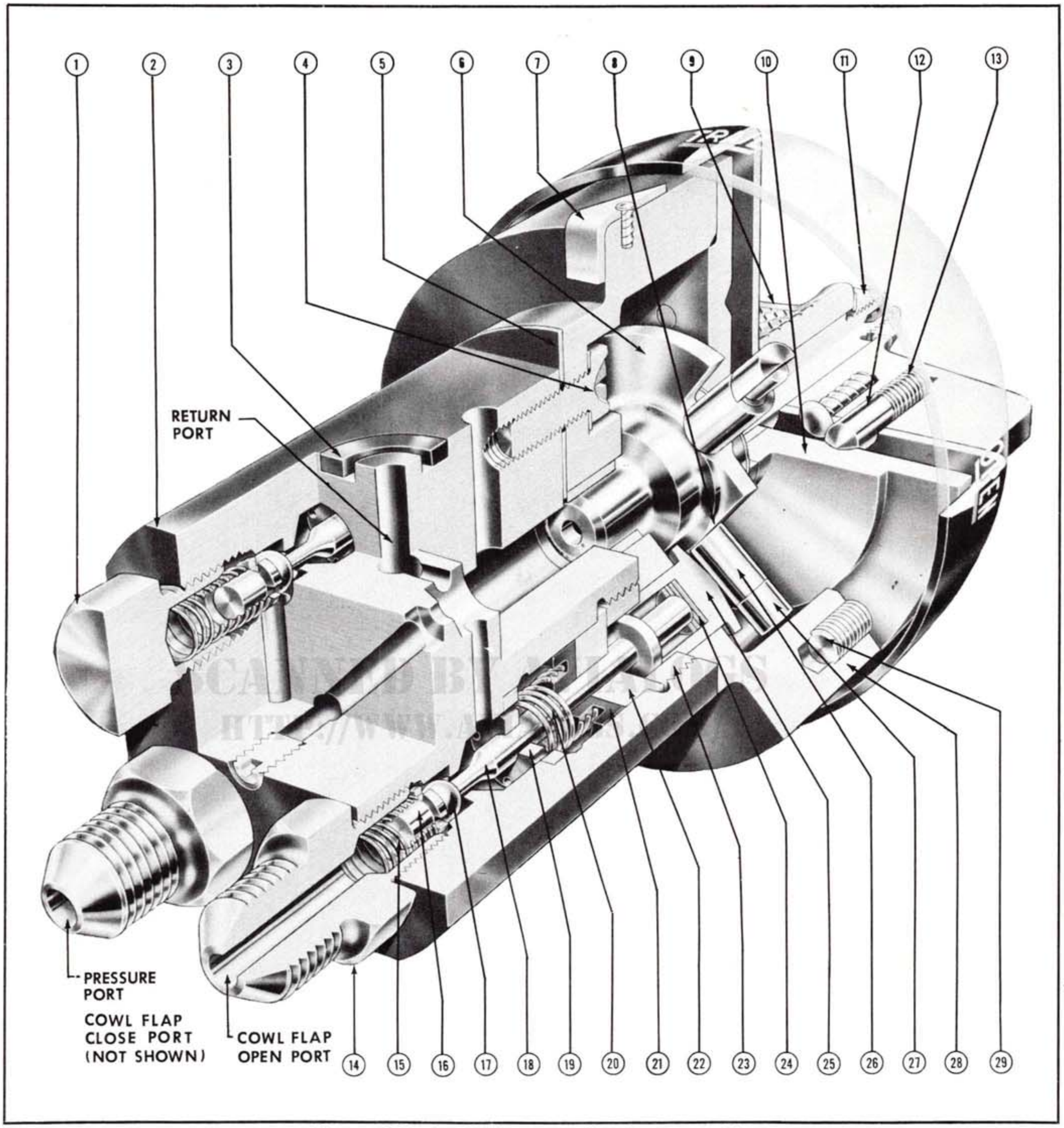

①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
⑫
⑬
RETURN PORT
PRESSURE PORT
COWL FLAP CLOSE PORT (NOT SHOWN)
COWL FLAP OPEN PORT
⑭
⑮
⑯
⑰
⑱
⑲
⑳
㉑
㉒
㉓
㉔
㉕
㉖
㉗
㉘
㉙

Figure 422—Cowl Flap Control Valve Assembly

KEY TO FIGURE 422—Continued

Item	*Part No.*	*Part Name*	*No. Req*
1	1202457	Plug	1
2	5143672	Body Assembly	1
3	143908-016SR-022-094	Washer	(Ref)
4	AF501-10-10	Screw	2
	AF936A10-10	Lock Washer	2
5	1143605	Plate	1
6	4143612	Rotor Assembly	1
	Consists of:		
	4143612-2	Shaft	1
	146142-127-026	Pin	2

KEY TO FIGURE 422—Continued

Item	*Part No.*	*Part Name*	*No. Req*
7	1143602	Indicator	1
	AN535-00-3	Drive Screw	1
**8	143908-005R010-010	Washer	2
	143908-005R010-018	Washer	2
	143908-005R010-022	Washer	2
9	4143613-2 or	Handle Assembly	1
	4143613-3	Handle Assembly	1
	Consists of:		
	2202210	Handle	1
	2143674-2 or	Guard	1
	2143674-3	Guard	1
	AN535-6-8	Drive Screw	2
10	4143614	Cover Assembly	1
	Consists of:		
	4143614-2	Cover	1
	1143673	Bushing	1
	146142- 127-013	Pin	2
11	22K1-02	Cap Nut	1
12	1143606	Plunger	1
13	1143607	Spring	1
14	1143604	Fitting	3
15	1143603	Spring	4
16	1143609	Guide	4
17	3/16 inch dia.	Bright Steel Ball	4
18	1143601	Stem	4
19	1143598	Retainer	4
20	1143610	Spring	4
21	1049003-D-004	Packing Cup	4
22	1143596	Guide	4
23	1143597	Gland	4
*24	143908-000B-006-005	Shim	8
	143908-000B-006-010	Shim	4
	143908-000B-006-020	Shim	4
	143908-000B-006-040	Shim	8
	143908-000B-006-125	Shim	4
25	1143611	Tappet Head	4
26	1143599	Roller Assembly	2
	Consists of:		
	1143599-2	Roller	2
	1143599-4	Bushing	2
27	1143600	Cap	2
28	4143615	Housing Assembly	1
	Consists of:		
	4143615-2	Housing	1
	A-404-1	Oilite Bushing	1
29	AF501A10-10	Screw	4
	AF995C40-6	Lock Wire	2

*Use as necessary to obtain proper height of tappet heads.

**Use as necessary to obtain .010 to .020 end play for both rollers.

Note

4143736 valve and bracket assembly consists of the following parts:

Part No.	*Part Name*	*No. Req*	*Part No.*	*Part Name*	*No. Req*
5143815	Valve Assembly	2	AF995C40-6	Lock Wire	2
5072943	Bracket Assembly	2	110242-4-12AH	Bolt	2
AF895B70	Plug	1	AN3-27A	Bolt	2
AF365-1032	Nut	2	143908-016SR-022-094	Washer	2
AN960-D10	Washer	4	AF811CT-4	Elbow	1

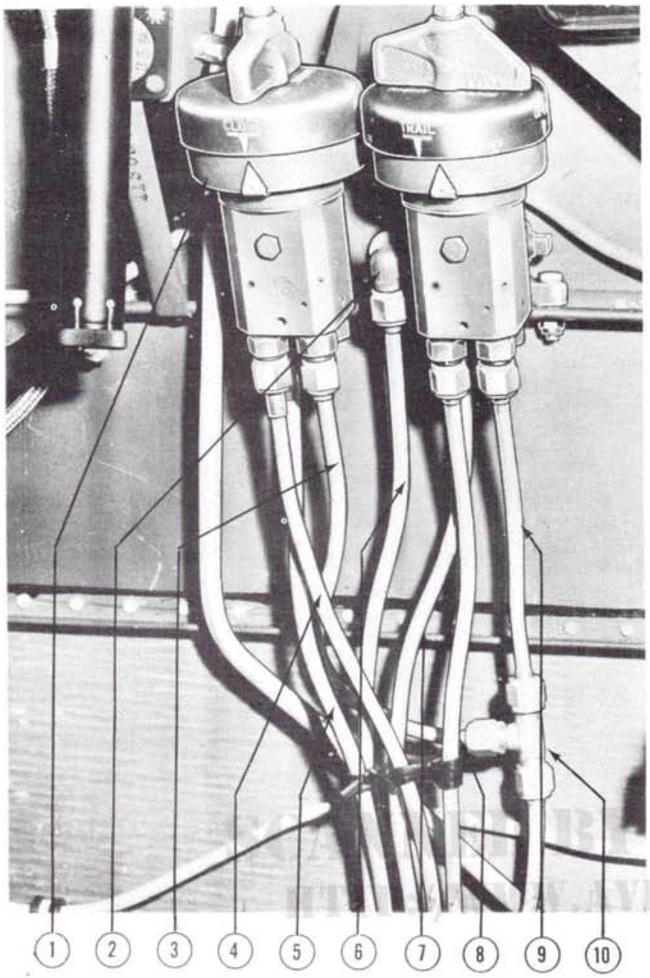


Figure 423—Cowl Flap Control Valve Assembly Installed

1. 4143736 Valve and Bracket Assembly
2. AF811CT-4 Elbow and AN901-4A Gasket
3. 5112589-16 Cowl Flap Pressure Line
4. 5112589-23 LH Cowl Flap Close Line
5. 5112589-21 LH Cowl Flap Open Line
6. 5112589-19 Cowl Flap Return Line
7. 5112589-25 RH Cowl Flap Open Line
8. 5112589-27 RH Cowl Flap Close Line
9. 5112589-15 Cowl Flap Pressure Line
10. 1141672 Tee

(*c*) MAINTENANCE REPAIR OR REPLACEMENT.

1. Slight external fluid leakage of the cowl flap actuating cylinder may be remedied by moderate tightening of the cylinder end.

2. If he cowl flap actuating cylinder is damaged or is not functioning properly, replace it with a new part.

(*d*) ADJUSTMENTS.—To adjust the cowl flap actuating cylinder with the cowl flap operating mechanism refer to paragraph 5. *e.*(4), this section.

(*e*) TESTS BEFORE INSTALLATION.—Refer to figures 417 and 418 and for fluid leak tests of the cowl flap actuating cylinder.

(*f*) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—Refer to figures 417 and 418 and observe the following instructions when assembling the cowl flap actuating cylinder.

a. Thoroughly remove oil and grease and wipe all parts clean before assembling the cylinder.

b. Install washers as required to obtain clearances specified in figure 417.

c. Apply 50 foot-pounds wrench torque to tighten the cylinder ends (figure 417).

d. Adjust stroke to 1 inch and lock.

2. INSTALLATION.—To install the cowl flap actuating cylinder in bracket assembly, reverse the removal procedure. When adjusting the cylinder in the bracket, the mounting screws should only be brought down to where the cylinder assembly will swing freely in the support bracket without side play. After this is accomplished, the cylinder should be checked for end play. If end play is detected, the point on the screws and the trunnion socket in the cylinder should be checked for wear. If wear is noted, the screw or cylinder, or both, should be replaced with a new part.

(*g*) MAJOR OVERHAUL.

1. Remove and disassemble the cowl flap actuating cylinder according to preceding instructions.

2. Install new packing cups or rings.

3. Inspect all other parts for wear, corrosion, or scratches; make necessary replacements with new parts.

COURTESY OF AVIALOGS

4. Refer to figure 420 for rework tolerances of the cowl flap actuating cylinder.

5. When rework is completed, assemble the cylinder and test for fluid leaks according to figures 417 and 418.

f. WING FLAP HYDRAULIC SYSTEM.
(See figure 424.)

(1) GENERAL.—The wing flaps are of the split trailing-edge type and are actuated by a hydraulic actuating cylinder through a series of rods, rollers, and turnbuckles. The wing flaps are controlled by the wing flap control valve located on the hydraulic control panel (figure 361). The position of the wing flaps is indicated on the wing flap indicator (figure 431), located on the bottom of the main instrument panel directly forward of the pilot's seat. The wing flap relief valve prevents the lowering of the wing flaps at an indicated air speed greater than 112 mph. (See figures 425 and 426.) When the wing flap control valve handle is placed in the "DOWN" position, fluid under pressure is directed through the control valve to the wing flap relief valve and into the DOWN line which connects to the forward end of the wing flap actuating cylinder. As the cylinder piston extends and the cylinder rolls forward, the linkage connected to the actuating cylinder pulls the push-pull rods inward, lowering the wing flaps. The fluid in the aft end of the actuating cylinder flows through the wing flap UP line to the wing flap control valve and into the return manifold to the hydraulic reservoir. When the wing flap control valve handle is placed in the "UP" position, the flow of fluid is reversed. The actuating piston

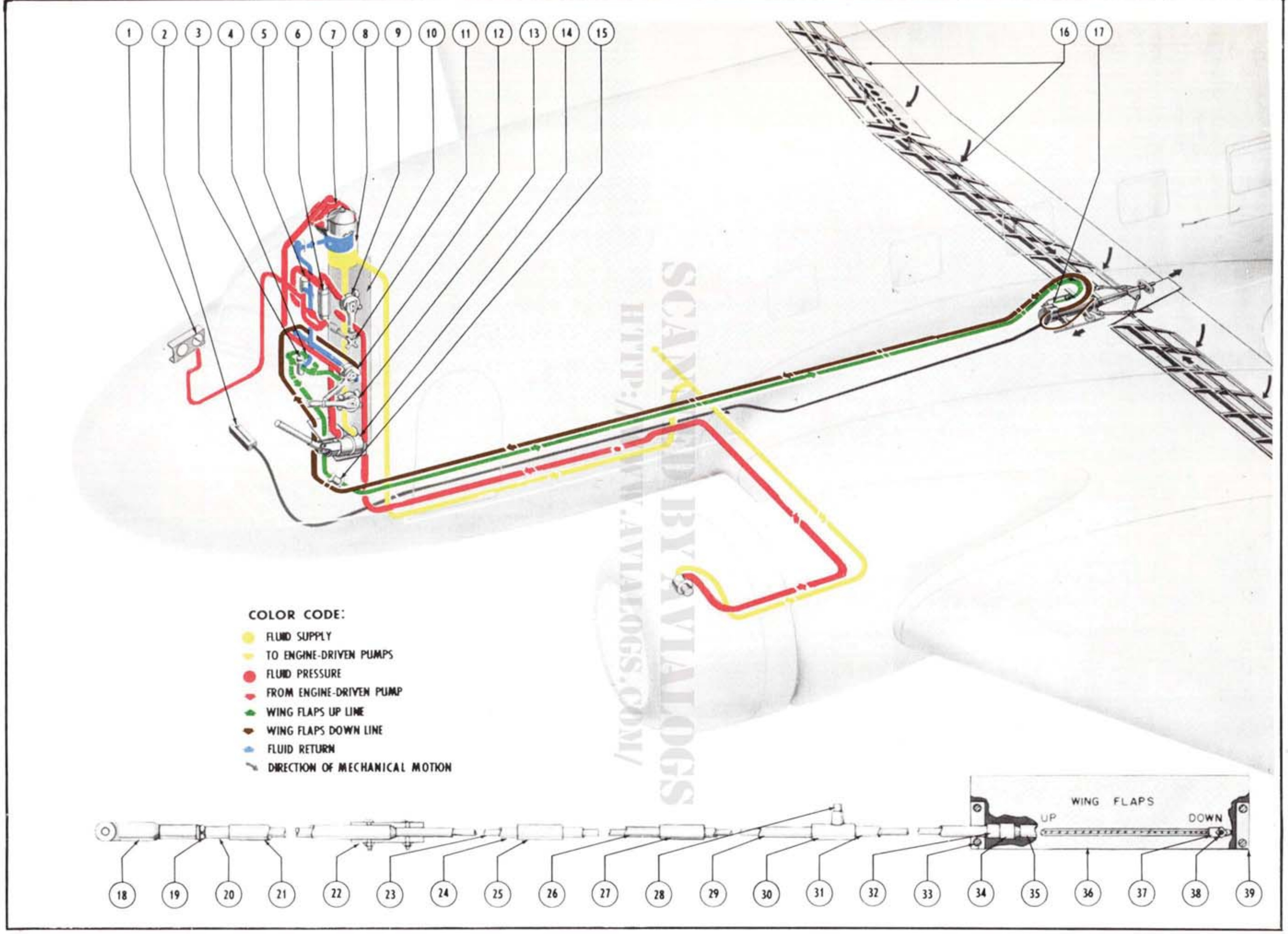

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
COLOR CODE:
● FLUID SUPPLY
▸ TO ENGINE-DRIVEN PUMPS
● FLUID PRESSURE
▸ FROM ENGINE-DRIVEN PUMP
▸ WING FLAPS UP LINE
▸ WING FLAPS DOWN LINE
▸ FLUID RETURN
↘ DIRECTION OF MECHANICAL MOTION
WING FLAPS
UP
DOWN
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39

Figure 424—Wing Flap Hydraulic System and Wing Flap Indicator

KEY TO FIGURE 424

(Douglas Dwg. Nos. 5110553, 5141942, 5110513, 5141943, and 3118562)

1. Hydraulic System Pressure Gage
2. Wing Flap Indicator (See detail)
3. Wing Flap Relief Valve Assembly (See figure 432)
4. Check Valve
5. Hydraulic System Pressure Relief Valve (See figure 375)
6. Hydraulic System Pressure Regulator (See figure 369)
7. Hydraulic System Pressure Accumulator (See figure 367)
8. Hydraulic System Fluid Reservoir (See figure 374)
9. Engine-Driven Hydraulic Pump Selector Valve (See figure 366)
10. Hydraulic Control Panel (See figure 361)
11. Hand Pump to Pressure Accumulator Shut-off Valve (See figure 383)
12. Wing Flap Control Valve (See figure 390)
13. Landing-Gear Control Valve (See figure 390)
14. Hydraulic Hand Pump (See figure 376)
15. Orifice Check Valve
16. Wing Flaps
17. Wing Flap Actuating Cylinder (See figures 427 and 428)

Item	*Part No.*	*Part Name*	*No. Req*
18	AN486-3	Clevis	1
19	AN316-4R	Nut	1
20	1119754	Rod	1
21	1119755	Tube	1
22	1119756	Clamp	1
	AN515-8-14	Screw	4
	AF365D832	Nut	4
23	3118562-10	.063 x 320 in. Steel Music Wire	1
24	3118562-6	3/16 OD x .035 x 122 in. C.M. Steel Tube	1
25	3118562-4	5/16 OD x .095 x 1-7/16 in. C.M. Steel Tube	1
26	3118562-18	3/16 OD x .035 x 90 in. C.M. Steel Tube	1
27	3118562-4	5/16 OD x .095 x 1-7/16 in. C.M. Steel Tube	1
28	AN295-40	Oil Cup or No. 47 Zerk Fitting	1
29	3118562-20	3/16 OD x .035 x 90 in. C.M. Steel Tube	1
30	3118562-2	Tube Assembly	1
	Consists of:		
	3118562-12	5/16 Dia x 1/2 in. Bar L.C. Steel	1
	3118562-14	5/16 OD x .095 x 1-3/8 in. C.M. Steel Tube	1
31	3118562-21	3/16 OD x .035 x 10 in. C.M. Steel Tube	1
32	3118562-16	5/16 OD x .049 x 3/4 in. C.M. Steel Sleeve	1
33	1119656-2	Clamp	1
	AN515-8-14	Screw	2
	AF365-D832	Nut	2
34	1119753	Stop	1
35	1119757	Tube	1
36	2119657	Plate	1
37	1119758	Plug	1
38	1119759	Screw	1
39	1119656-1	Clamp	1
	AN515-8-14	Screw	2
	AF365-D832	Nut	2

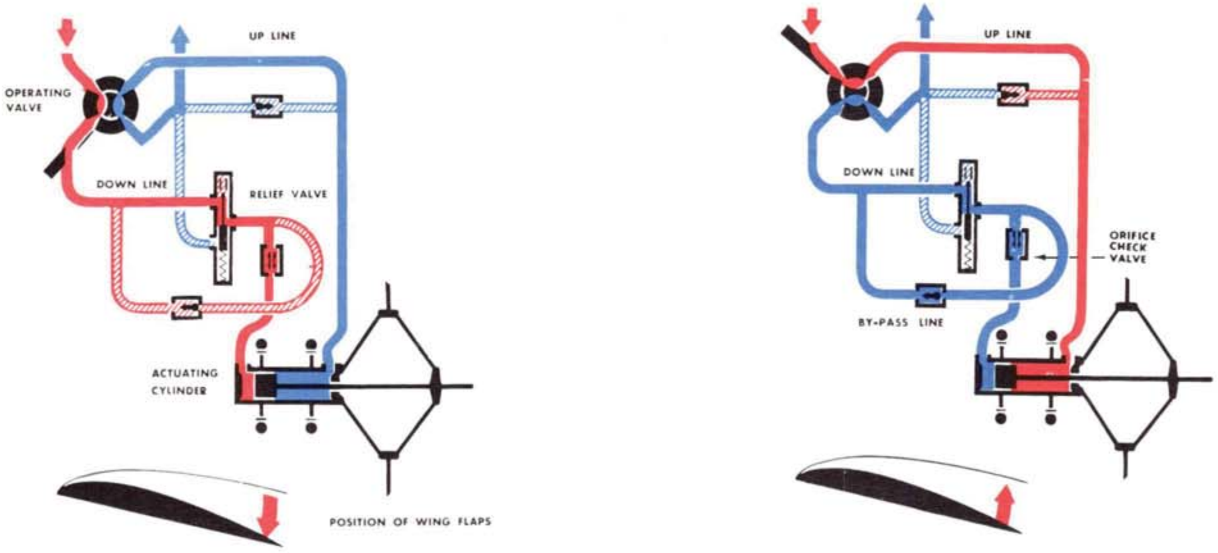
Note

For tubing and fittings information refer to figure 637, section VIII.

retracts, the actuating cylinder moves aft, and the operating linkage pushes the push-pull rods outwardly and raises the flaps. When the control valve handle is placed in the "NEUTRAL" position, the control valve plug blocks the flow of fluid either to or from the actuating cylinder and the wing flaps are locked in position. The bypass line and check valve installed around the wing flap relief valve prevent back pressure from building up in the wing flap DOWN line because of the resistance to flow of the return fluid through the wing flap relief valve. The bypass line provides a free passage for the return fluid when the wing flaps are raised and the check valve prevents any flow through the bypass line when the wing flaps are lowered.

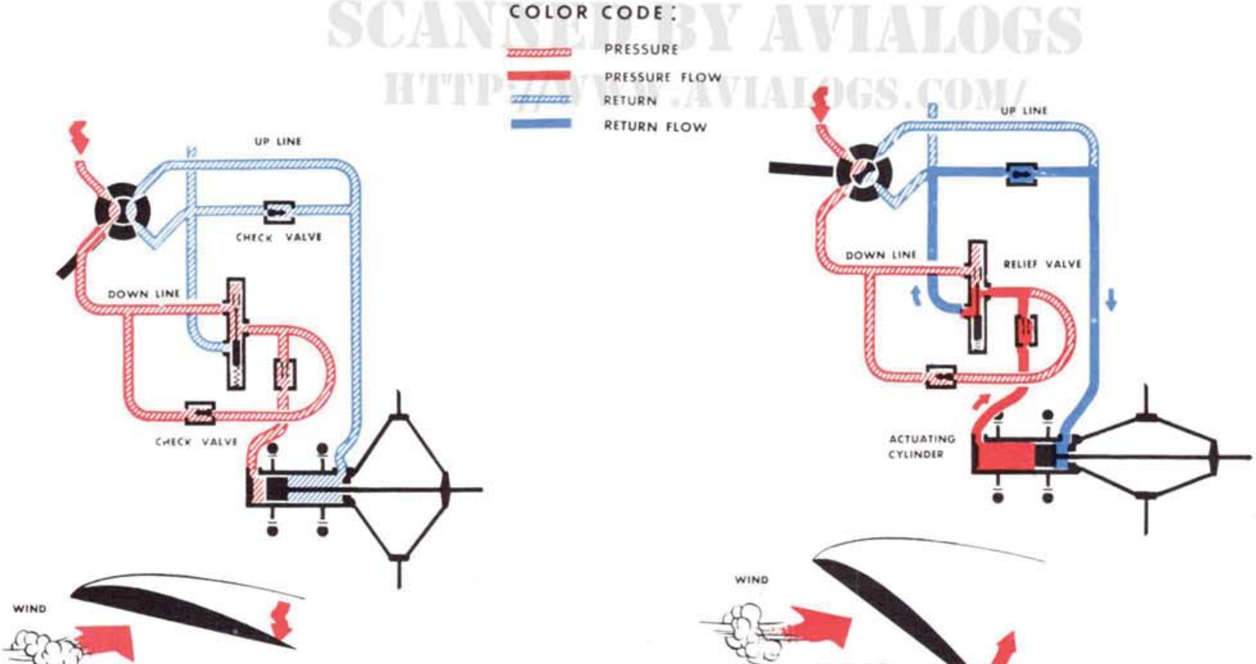
CAUTION

The wing flap control valve handle should be returned to the "NEUTRAL" position after each operation of the wing flaps in flight. When the airplane is on the ground, the control handle should be in the "UP" position at all times so that excess fluid pressure in the wing flap system, caused by thermal expansion, may be relieved by having the wing flap operating lines connected to the pressure and return manifolds.


UP LINE
OPERATING VALVE
DOWN LINE
RELIEF VALVE
ACTUATING CYLINDER
POSITION OF WING FLAPS
UP LINE
DOWN LINE
ORIFICE CHECK VALVE
BY-PASS LINE

NORMAL DOWN FLOW:
The **DOWN** position of the operating valve handle directs the fluid pressure into the down line. Valve piston remains in normal position allowing down flow unless down line pressure exceeds approximately 485 lbs. per sq. in. Wing flaps move down.

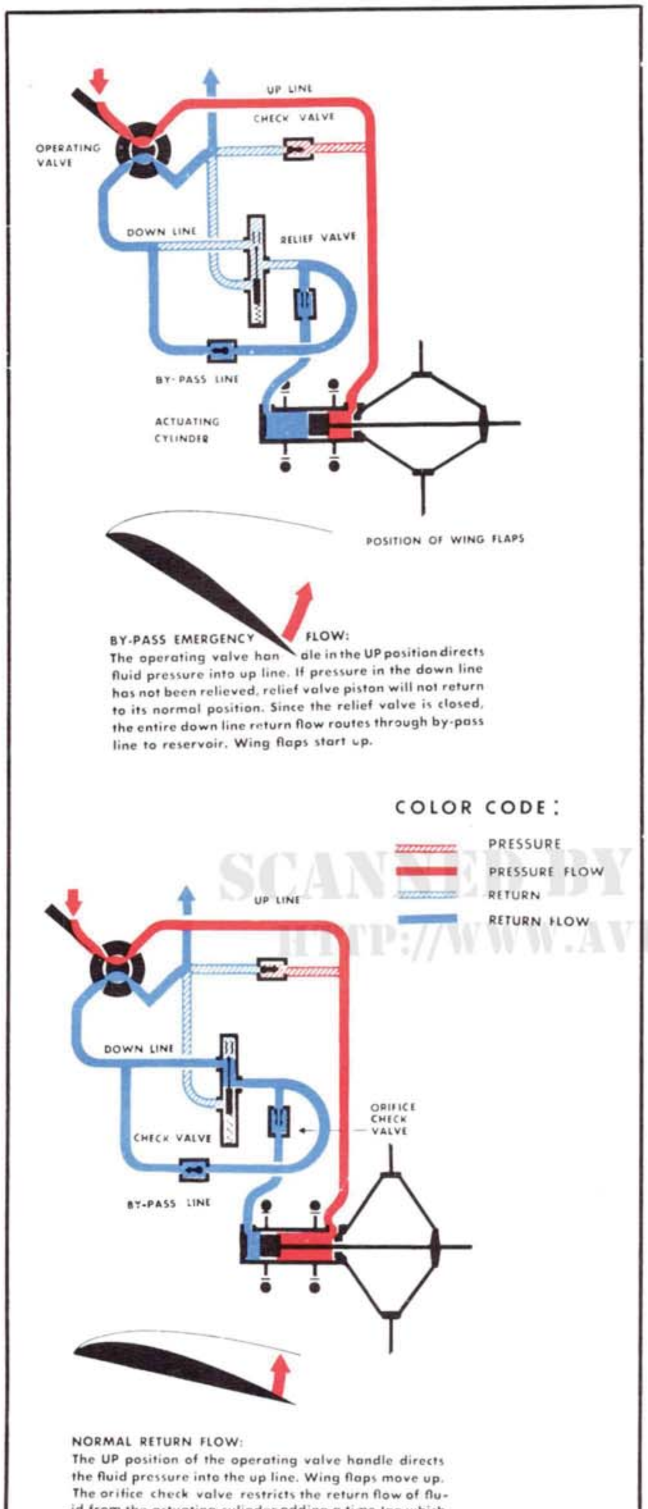
NORMAL RETURN FLOW:
The by-pass line is an emergency measure for almost instantaneous return of relief valve piston to its normal position. When by-pass line flows (as in the previous diagram) the pressure drop in the down line allows spring to raise relief valve piston. Normal return flow of fluid results.


COLOR CODE:
PRESSURE
PRESSURE FLOW
RETURN
RETURN FLOW
UP LINE
CHECK VALVE
DOWN LINE
CHECK VALVE
WIND
UP LINE
DOWN LINE
RELIEF VALVE
ACTUATING CYLINDER
WIND

SYSTEM FLOW BLOCKED:
The **DOWN** position of the operating valve handle directs fluid pressure into the down line. Wing flaps move down. Back pressure in down line caused by strong wind resistance on wing flaps forces down the relief valve piston blocking entire system flow. Downward movement of wing flaps is halted.

RELIEF FLOW:
The **NEUTRAL** position of the operating valve handle blocks flow in wing flap system. Strong wind resistance on wing flaps causes fluid back pressure to flow through relief port. Wind raises wing flaps until back pressure is relieved. Note: When wing flaps are entirely down, mechanical leverage prevents wind load from forcing them up.

Figure 425—Wing Flap Hydraulic System, Normal Flow


UP LINE
CHECK VALVE
OPERATING VALVE
DOWN LINE
RELIEF VALVE
BY-PASS LINE
ACTUATING CYLINDER
POSITION OF WING FLAPS
UP LINE
DOWN LINE
ORIFICE CHECK VALVE
CHECK VALVE
BY-PASS LINE
COLOR CODE:
PRESSURE
PRESSURE FLOW
RETURN
RETURN FLOW

BY-PASS EMERGENCY FLOW:
The operating valve handle in the UP position directs fluid pressure into up line. If pressure in the down line has not been relieved, relief valve piston will not return to its normal position. Since the relief valve is closed, the entire down line return flow routes through by-pass line to reservoir. Wing flaps start up.

NORMAL RETURN FLOW:
The UP position of the operating valve handle directs the fluid pressure into the up line. Wing flaps move up. The orifice check valve restricts the return flow of fluid from the actuating cylinder adding a time lag which prevents rapid raising of wing flaps and consequent sudden loss of lift in flight.

Figure 426—Wing Flap Hydraulic System, Bypass Flow

(2) WING FLAP CONTROL VALVE.—For general description of this valve see this section, paragraph 13.*c.*(2)*(a)*.

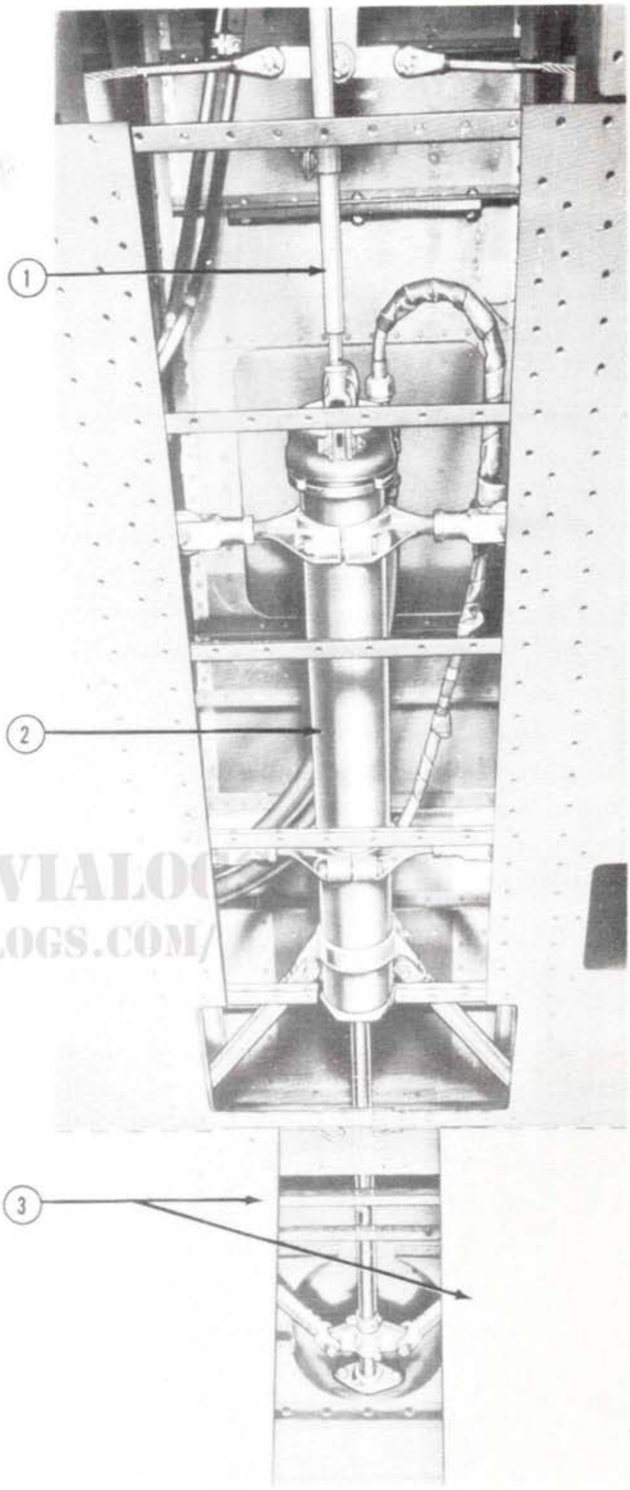
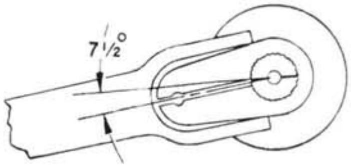


Figure 427—Wing Flap Actuating Cylinder Installed

1. Wing Flap Indicating Wire
2. Wing Flap Actuating Cylinder
3. Wing Flaps

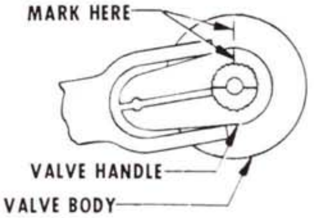
(a) WING FLAP CONTROL VALVE— EARLY AIRPLANES. *(See figure 390.)*

1. DESCRIPTION.—This valve is identical with the landing gear control valve on early airplanes as described in this section, paragraph 13.*c.*(2)*(b)*.



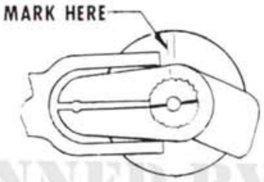
A

ALIGN SCRIBED MARK ON VALVE SHAFT WITH UPPER SIDE OF SLOT IN WING FLAP VALVE HANDLE. PLACE WING FLAP VALVE HANDLE IN NEUTRAL POSITION AND BUILD UP HYDRAULIC PRESSURE BY OPERATING HYDRAULIC HAND PUMP UNTIL IT IS DIFFICULT TO OPERATE (HAND PUMP SHUT-OFF IN CLOSED POSITION).



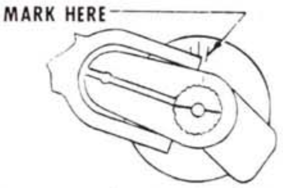
B

PLACE A PENCIL MARK 90° CLOCKWISE FROM SCRIBED MARK ON SHAFT VALVE HANDLE AND MAKE A CORRESPONDING MARK ON VALVE BODY.



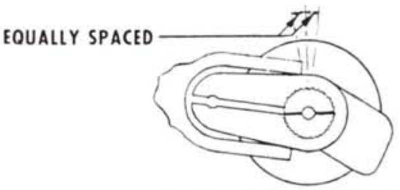
C

MAINTAIN PRESSURE ON HAND PUMP HANDLE AND SLOWLY MOVE THE VALVE HANDLE TO DOWN POSITION UNTIL A SLIGHT MOVEMENT IS NOTED ON THE HYDRAULIC HAND PUMP HANDLE. THIS INDICATES THE START OF OPENING OF THE VALVE. PLACE A PENCIL MARK ON THE VALVE BODY TO CORRESPOND WITH THE PENCIL MARK ON THE VALVE HANDLE. RETURN VALVE HANDLE TO NEUTRAL POSITION AND BUILD UP HYDRAULIC PRESSURE BY OPERATING HYDRAULIC HAND PUMP UNTIL IT IS DIFFICULT TO OPERATE.



D

MAINTAIN PRESSURE ON HAND PUMP HANDLE AND SLOWLY MOVE THE VALVE HANDLE TO UP POSITION UNTIL A SLIGHT MOVEMENT IS NOTED ON THE HYDRAULIC HAND PUMP HANDLE. THIS INDICATES THE START OF OPENING OF THE VALVE. PLACE A PENCIL MARK ON THE VALVE BODY TO CORRESPOND WITH PENCIL MARK ON VALVE HANDLE.



E

PENCIL MARKS ON BODY SHOULD BE EQUALLY SPACED. UNEQUAL SPACING INDICATES IMPROPER TIMING OF VALVE OPENING AND HANDLE SHOULD BE RELOCATED ON SERRATIONS TO CORRECT TIMING OF VALVE OPENING.

Figure 427A—Timing Wing Flap Control Valve, Late Airplanes

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

(2) Disconnect and cap the four hydraulic lines leading to the wing flap control valve.

(3) Remove the bolts that attach the valve to the hydraulic control panel and remove the valve from the airplane.

b. DISASSEMBLY.—The wing flap control valve should not be disassembled in the field. When disassembly is attempted refer to figure 390 and the instructions given in paragraph 13.*c.*(2)*(a)2.*

3. MAINTENANCE REPAIR OR REPLACEMENT.—Refer to this paragraph *c.*(2)*(a)3.*

4. TESTS BEFORE INSTALLATION.—Refer to figure 390 for fluid leak tests of the wing flap control valve.

5. ASSEMBLY AND INSTALLATION

a. ASSEMBLY. — Reverse the disassembly procedure given in this paragraph *c.*(2)*(b)* and refer to figure 390.

b. INSTALLATION.—Reverse the removal procedure outlined in this paragraph *f.*(2)*(a)2.*

6. MAJOR OVERHAUL.—Refer to this paragraph *c.*(2)*(g).*

(b) WING FLAP CONTROL VALVE—
LATE AIRPLANES. *(See figure 390A.)*

1. DESCRIPTION.—This valve is identical with the landing gear control valve on late airplanes, with the exception of the timing. For detailed description of the valve refer to this section, paragraph 13.*c.*(2)*(c).*

2. REMOVAL AND DISASSEMBLY.—To remove and disassemble this valve refer to the instructions for the hydraulic pump selector valve, this section, paragraph 13.*b.*(4)*(c)2.*

3. MAINTENANCE REPAIRS.—For maintenance repair refer to instructions for the hydraulic pump selector valve, this section, paragraph 13.*b.*(4)*(c)3.*

4. ASSEMBLY.—To assemble this valve refer to instructions for the hydraulic pump selector valve in this section, paragraph 13.*b.*(4)*(c)4.*

5. ADJUSTMENTS.

a. Timing of the wing flap control valve is accomplished as described in figure 427A. These instructions must be followed carefully, as even the slightest deviation will cause imperfect timing.

b. The design of this valve incorporates spring loading of the shear-seals in static condition, and hydraulic loading of the shear-seals in operation; handle load adjustment is, therefore, dispensed with.

CAUTION

It is urgently important that the handle of this valve be moved its entire travel in operation. Stopping even slightly short of full "NEUTRAL" or full "OPEN" position allows unloading of the valve through the body.

6. TESTS BEFORE INSTALLATION.—This valve is tested for leakage by applying pressure, from a hand or motor operated hydraulic pump, as outlined in tabulation under figure 390B.

Note

Use hydraulic fluid per Specification AN-VV-O-366 or equivalent. Bleed all air out of the unit prior to test.

7. INSTALLATION.—Attach the wing flap control valve to the hydraulic control panel, using AN3-6A bolts and AN935-10 lock washers.

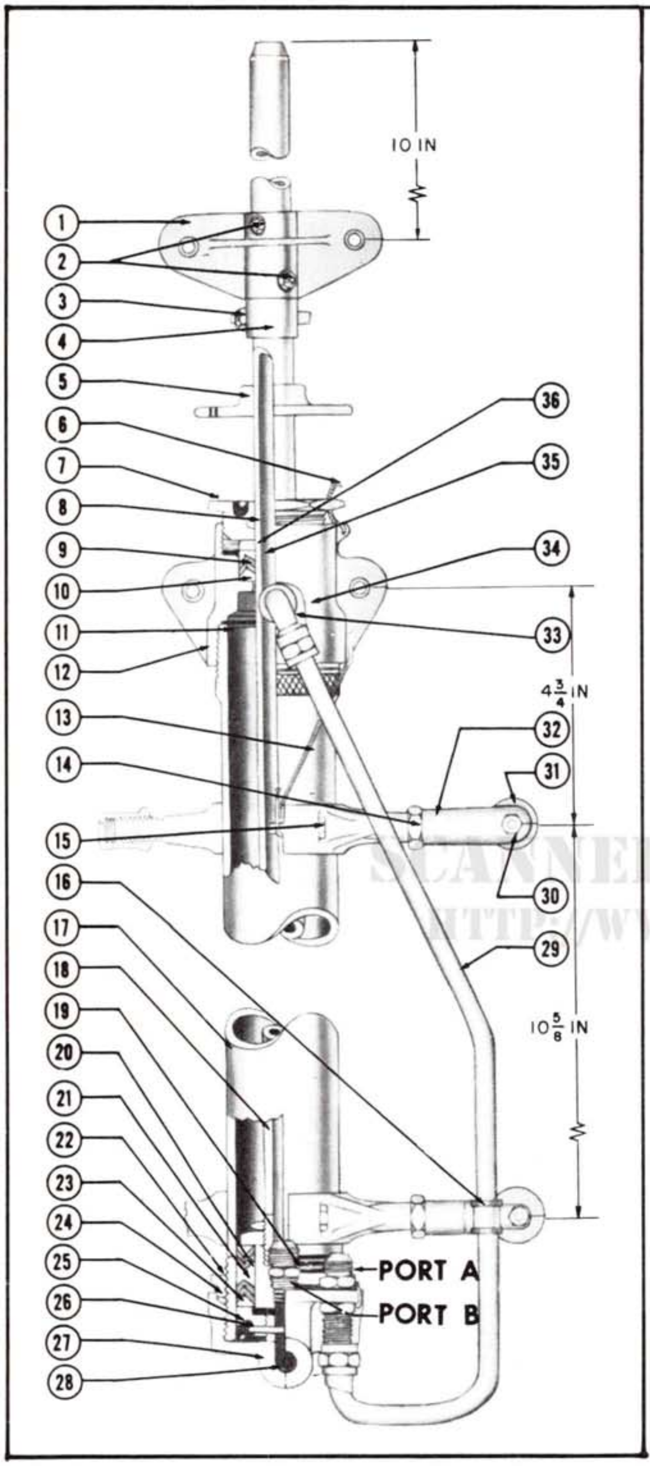

10 IN
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
36
35
34
33
4 3/4 IN
32
31
30
29
10 5/8 IN
PORT A
PORT B

Figure 428—Wing Flap Actuating Cylinder Assembly—C-47A and Early C-47B Airplanes

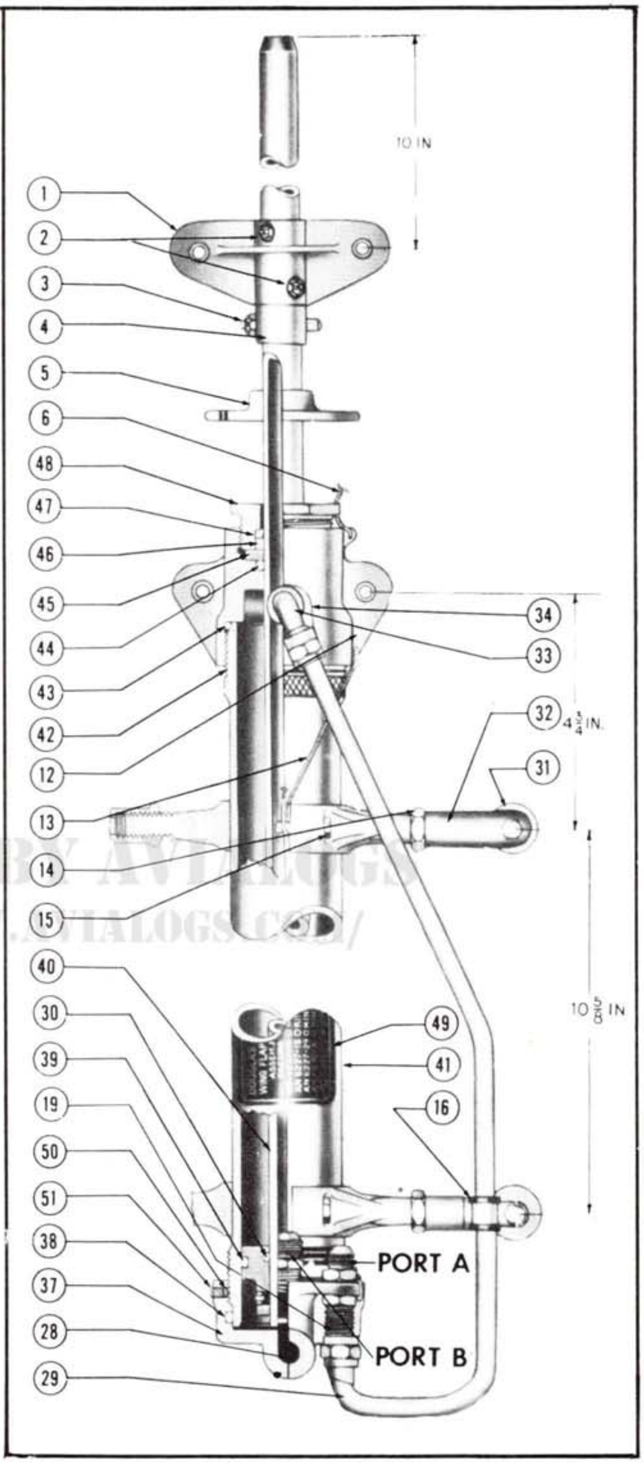

10 IN
1
2
3
4
5
6
48
47
46
45
44
43
42
12
13
14
15
40
30
39
19
50
51
38
37
28
29
34
33
32
4 3/4 IN.
31
10 5/8 IN
49
41
16
PORT A
PORT B

Figure 428A—Wing Flap Actuating Cylinder Assembly—Late C-47B Airplanes

TEST PROCEDURE

Test Port	*Piston Position*	*Test Pressure*	*Max. Leakage*
A	Retracted	1200 psi	2 drops—12 hrs external 10 drops per hr internal
B	Extended	1200 psi	2 drops—12 hrs external 10 drops per hr internal

KEY TO FIGURES 428 and 428A

Item	*Part No.*	*Part Name*	*No. Req*
1	2118041	Block	1
	Includes:		
	116500-4C-012	Bushing	2
2	AF386-2-9A	Pin	2
	AF975-3	Washer	2
	AF365-1032	Nut	2
3	AF386-2-8A	Pin	1
	AF975-3	Washer	1
	AF365-1032	Nut	1
4	1118052	Collar	1
5	1118051	Bearing	1
6	AF995C40-4	Lock Wire	1
7	1118050	Nut	1
8	126221-3-12-18	Washer	1
9	40B629-12-024	Linear Packing	*2
	(L-3413) or		
	5135865-6N-024	Nuckles Packing (Optional)	
		*Use two or three as necessary to provide sufficient take-up.	
10	1012954-D024-012	Ring	1
11	AN900-34	Gasket	1
12	2118039	Base	1
	Includes:		
	116500-4C-012	Bushing	2
13	AF995C40-14	Lock Wire	1
14	AN316-8R	Nut	4
15	AN3-20A	Bolt	4
	AN960-10	Washer	4
	AF365-1032	Nut	4
16	755-6-2-8	Adel Clip	1
17	2117772	Cylinder	1
18	2118040	Piston Assembly	1
	Consists of:		
	1118044	Rod Assembly	1
	1118046	Head	1
	1118047	Nut	1
19	3115-2HT-6D	Bulkhead Union	1
	11-1039-1-5D	Nut	1
20	1118049	Spacer	1
21	40B629-12-110 (L-3413)	Linear Packing	4
	or 5135865-6N-110	Nuckles Packing (Optional)	4
22	2118399	Nut	1
23	1012954-D110-012	Ring	2
24	1111908-214-220-188	Gasket	1
25	1118048	Bearing	1
26	AN380-4-7	Cotter	1
27	4117383	Cap	1
28	AF895-101	Hex. Plug	1
29	2117251-1	Line	1
30	AN3-11	Bolt	4
	1118160	Bearing	4
	AN960-10	Washer	4
	AN320-3	Nut	4
	AN380-2-2	Cotter	4
31	1118160	Roller	4
32	2118042	Support	2
33	6-CT-S	Elbow	1
34	1012953-D024-012	Ring	1
35	143908-.024D-114-187	Washer	1
36	AN6227-15	"O" Ring Packing	1

KEY TO FIGURES 428 and 428A—Continued

Item	*Part No.*	*Part Name*	*No. Req*
37	4129534	Cap	1
38	AN6230-6	"O" Ring Gasket	1
39	AN6227-29	"O" Ring Packing	1
40	2209971	Piston Assem.	1
41	2209976	Cylinder	1
42	4209977	Base Assem.	1
	AAF995-41 -14	Lockwire	1
43	AN6230-6	"O" Ring Gasket	1
44	AN6227-15	"O" Ring Packing	1
45	1209969	Retainer	1
46	AN6232-1	(Stock Length-5) Wiper	1
47	AN6231-5	Wiper	1
48	1209974	Nut	1
	AAF995-41-4	Lockwire	1
49	1189543	Decal	1

Rework Tolerances on Late C-47B Airplanes

A. If diametral clearance between housing and piston rod exceeds .007, rework to .001 to .007 by replacing housing or reworking piston rod.

B. Manufacturing dimension of cylinder 2.000 to 2.003 ID.

C. Cylinder may be honed a maximum of .020 oversize.

D. Piston rod may be ground to a minimum diameter of .726. Piston may be chrome plated a maximum of .020 on a diameter.

E. If diametral clearance between piston head and cylinder exceeds .006, rework to .001 to .006 by chrome plating or replacing piston head.

(3) WING FLAP ACTUATING CYLINDER. *(See figures 428 and 428A.)*

(a) DESCRIPTION.—The wing flap actuating cylinder is mounted on rollers (figure 427) and located in the control tunnel in the center wing. Supports which carry the rollers are clamped to each end of the actuating cylinder. The rollers operate on rails mounted in the tunnel in the center wing. Four rods are connected to the piston and actuating cylinder forming a variable parallelogram. The rods also are attached to the push-pull rods in the wings. The push-pull rods are connected to the wing flaps by rods and turnbuckles. When the actuating cylinder extends, the cylinder moves forward on the rollers to produce an equalized force through the operating rods, pulling the push-pull rods inwardly and lowering the wing flaps. When the piston and cylinder retract the push-pull rods are forced outwardly and the wing flaps are raised.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

b. Remove the cover plate from the lower surface of the center wing section to gain access to the actuating cylinder. (See figure 427.)

c. Disconnect and cap the hydraulic lines leading to the wing flap actuating cylinder.

d. Disconnect the wing flap indicator wire from the wing flap actuating cylinder.

e. Disconnect the rods that attach to the piston rod and actuating cylinder.

f. Remove the roller bolts from one side of the actuating cylinder and remove the rollers.

g. Unbolt the auxiliary bearing on the piston rod.

h. Move the cylinder forward and up until it can be removed by backing down and out through the cut-out in the rib.

CAUTION

Do not remove the roller supports from the actuating cylinder since these are adjusted at the factory to insure alignment with the piston rod bearings.

2. DISASSEMBLY.

a. C-47A and early C-47B Airplanes.—Disassembly of the wing flap actuating cylinder should not be attempted in the field. When disassembly is attempted, refer to figure 428 and observe the following instructions:

(1) A suitable clamp must be used to prevent distorting the cylinder barrel when this part is clamped in a vise. This clamp should be in the form of two pieces of rubber-lined hardwood that extend the length of the barrel and encircle it to insure that the clamping pressure is distributed evenly over the entire area of the cylinder barrel. Place the clamp in a vise and tighten until the cylinder barrel is held securely.

(2) Cut the lock wire and unscrew the piston rod packing nut, using service tool No. K20001 (figure 429).

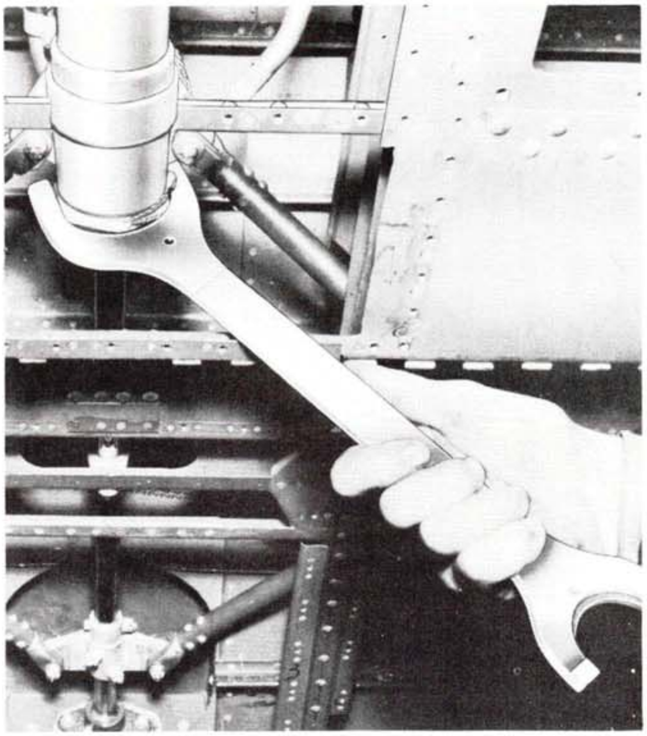


Figure 429—Use of Wing Flap Actuating Cylinder Piston Rod Packing Nut Wrench (Service Tool No. K20001)

(3) Remove the washers, packing, and packing rings.

(4) Unscrew the cylinder base.

(5) Remove and disassemble the piston assembly.

(6) Cut the lock wire and unscrew the packing nut from the cylinder cap. Remove the cylinder cap.

b. Late C-47B Airplanes.—Disassembly of the wing flap actuating cylinder should not be attempted in the field. When disassembly is attempted, refer to figure 428A and observe the following instructions:

(1) A suitable clamp must be used to prevent distorting the cylinder barrel when this part is clamped in a vise. This clamp should be in the form of two pieces of rubber-lined hardwood that extend the length of the barrel and encircle it to insure that the clamping pressure is distributed evenly over the entire area of the cylinder barrel. Place the clamp in a vise and tighten until the cylinder barrel is held securely.

(2) Cut the lock wire and unscrew the piston rod retaining nut.

(3) Remove the wipers, retaining ring, and packing rings.

(4) Unscrew the cylinder base.

(5) Remove and disassemble the piston assembly.

(6) Remove the lock screw from the cylinder cap. Remove the cylinder cap.

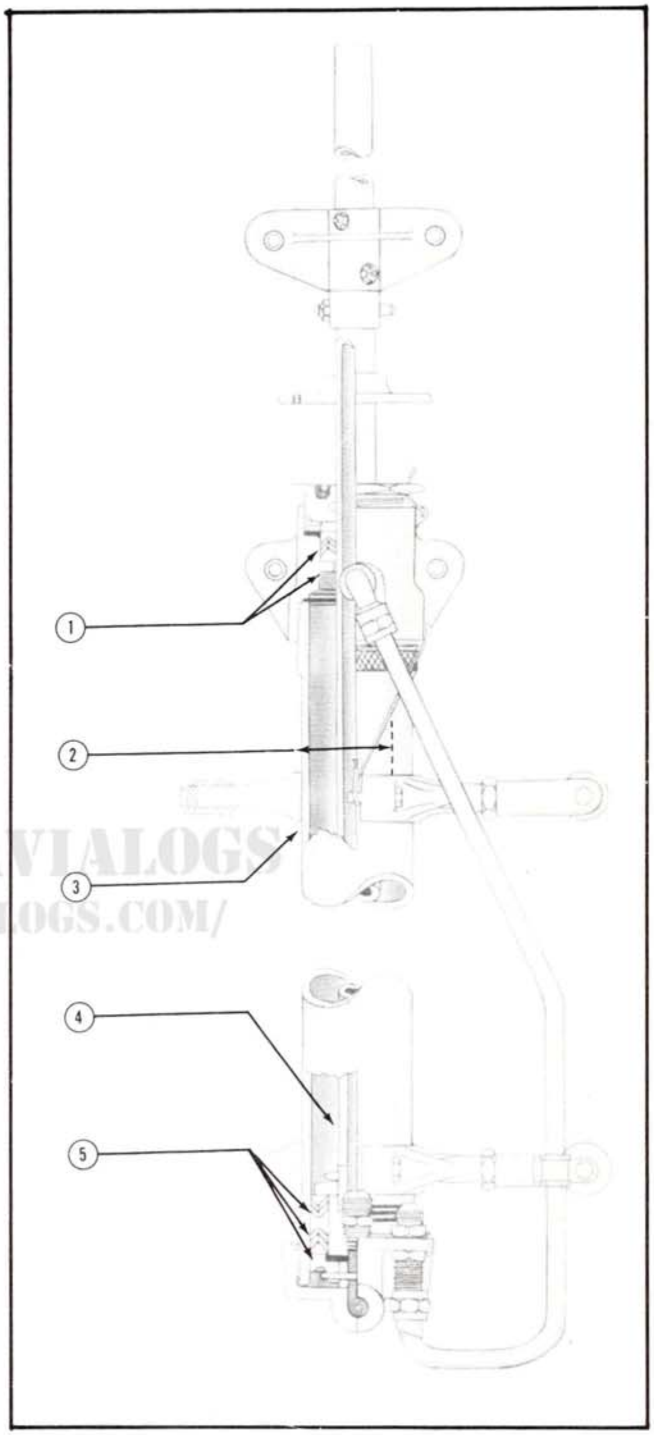


Figure 430—Rework Tolerances of Wing Flap Actuating Cylinder—C-47A and Early C-47B Airplanes

1. If diametral clearance between spacers and piston rod exceeds .020, rework to .004 to .008 by replacing spacers or reworking piston rod.
2. Manufacturing dimension of cylinder 2.064 to 2.062 ID.
3. Cylinder may be honed a maximum of .020 oversize.
4. Piston may be ground to a minimum diameter of .726. Piston may be chrome plated a maximum of .020 on a diameter.
5. If diametral clearance between spacers and cylinder exceeds .020, rework to .008 to .004 by replacing spacers.

(7) Remove the rubber plug from the cap lock-screw holes.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. External fluid leakage of the wing flap actuating cylinder may be remedied on early airplanes by moderate tightening of the packing nut by using service tool No. K20001 (figure 429). To fabricate the wrench, refer to figure 91. On later airplanes this is accomplished by replacing "O" Rings.

2. If the wing flap actuating cylinder is damaged or is not functioning properly, a new or serviceable cylinder should be installed.

(d) ADJUSTMENTS.—To adjust the wing flap operating mechanism and the wing flap actuating cylinder, refer to paragraph 12.*c*.(7)*(b)*, this section.

(e) TESTS BEFORE INSTALLATION.—Refer to figure 428 for fluid leak tests of the wing flap actuating cylinder.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the wing flap actuating cylinder, refer to figures 428 and 428A and reverse the disassembly procedure. On early airplanes only, use two or three piston rod packings, as required, to provide sufficient packing take-up. On late C-47B Airplanes replace all "O" rings before assembly.

2. INSTALLATION. — To install the wing flap actuating cylinder reverse the removal procedure.

(g) MAJOR OVERHAUL.

1. Remove and disassemble the wing flap actuating cylinder in accordance with preceding instructions.

2. Inspect all wearing surfaces for evidence of scratches and abrasions. Slight scratches may be buffed out carefully. For early airplanes refer to figure 430 for rework tolerances. On later airplanes refer to figures 428 and 428A.

3. Any wearing parts with deep scratches should be replaced with new parts.

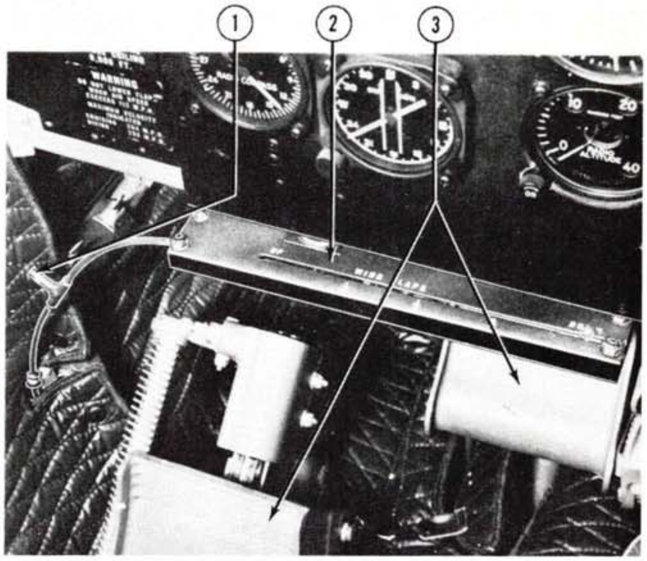


Figure 431—Wing Flap Indicator Installed

1. Lubrication Fitting
2. Wing Flap Indicator
3. Rudder—Brake Pedals

4. All packing removed during disassembly should be replaced with new parts, even if no fluid leakage has been observed. Packing in service for some time tends to take a permanent "set" with reference to surrounding parts, and may not seal properly if removed and reinstalled. All "O" rings should be replaced at each overhaul.

5. Inspect the general condition of all remaining parts and make necessary replacements with new parts. Assemble the actuating cylinder and test for fluid leaks as specified under figures 428 and 428A.

(4) WING FLAP RELIEF VALVE.
(See figure 432.)

(a) DESCRIPTION.—The wing flap relief valve is a part of the hydraulic control panel assembly (figure

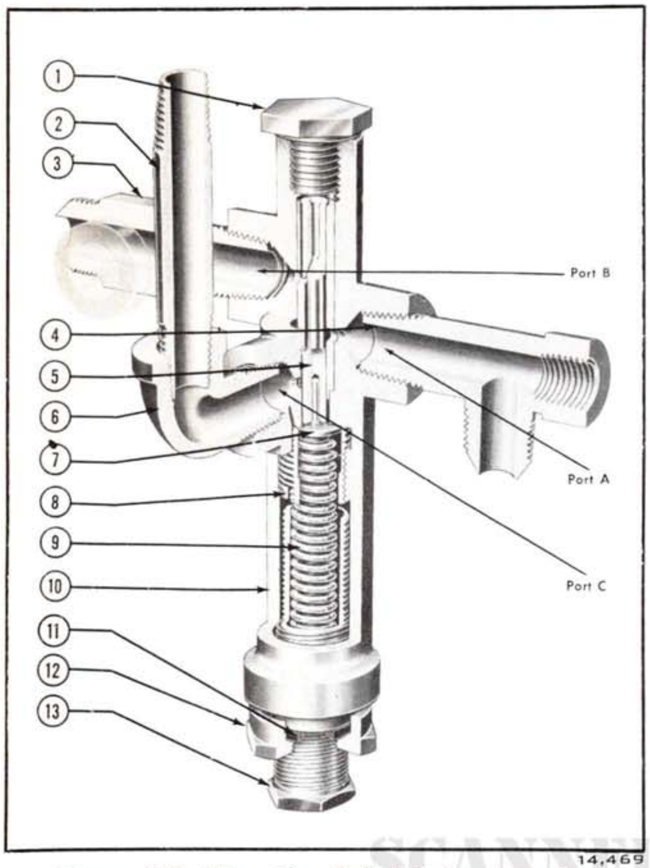


Figure 432—Wing Flap Relief Valve Assembly

362) and is located behind the wing flap control valve. The wing flap relief valve is installed in the wing flap DOWN line and limits the fluid pressure in the forward end of the wing flap actuating cylinder to approximately 485 psi to prevent damage to the wing flaps by excessive air loads. For a complete description of the operation and function of the wing flap relief valve refer to figures 425 and 426. The wing flap relief valve, which has three ports, consists essentially of a spring-loaded piston that slides in the valve body and controls the flow of fluid through the three ports of the valve.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

b. Disconnect and cap the hydraulic lines leading to the wing flap relief valve as shown on figure 433. Remove the valve from the airplane.

2. DISASSEMBLY.—Do not attempt to disassemble the wing flap relief valve in the field. Refer to figure 432 when it is necessary to disassemble the valve.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the wing flap relief valve is damaged or not functioning properly, replace it with a new or serviceable part.

(Douglas Dwg. No. 2119018)

TEST PROCEDURE

Test Port	*Ports Plugged*	*Test Pressure*	*Max. Leakage*	*Remarks*
A	B	400 psi	1/2 cubic inch per minute at port "C"	
C	A and B	120 psi	None	
B	A	1200 psi	10 cubic inches per minute at port "C"	
B	Gage at A	800 psi	10 cubic inches per minute at port "C"	Pressure 430 psi min at "A" 485 psi max.
B	None	80 ± 20 psi	———	Flow 2 GPM

Item	*Part No.*	*Part Name*	*No. Req*
1	1119007	Plug	1
	AN900-8	Gasket	1
	AF995C40-6L	Lock Wire	1
2	1119002	Nipple	1
3	8-6-6	Rot-Sparker Tee	1
4	4-6-8MRT-S	Parker Tee	1
5	1119008	Piston (Lap Fit in Body)	1
6	AF895-3	Elbow	1
7	1119009	Guide	1
8	1119011	Stop	1
9	1119013	Spring	1
10	2119020	Body (Includes 1119005 Sleeve)	1
11	143908-024GR030-125	Washer	1
12	1119003	Nut	1
13	1119012	Plug	1
	AF995C40-10	Lock Wire	1

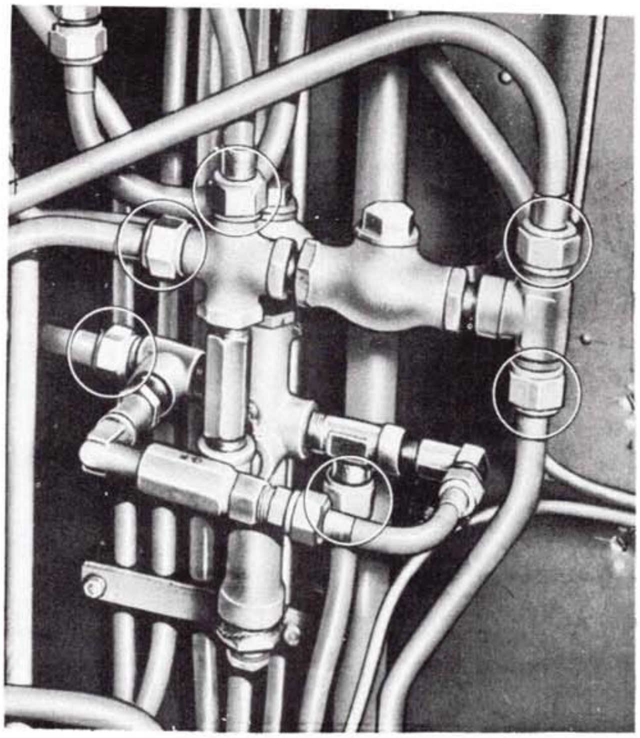


Figure 433—Removal of Wing Flap Relief Valve Assembly—Disconnect Locations Indicated

14,470

(d) ADJUSTMENTS.

1. Install 1000 psi fluid pressure gage at port A (figure 432).

2. Apply 800 psi at port B (figure 432).

3. Adjust the spring by turning the bottom plug (figure 432) so that 485 + 10 − 0 psi is indicated on the gage at port A. Fluid should flow at port C. The valve piston must reseat at 350 psi minimum pressure at port A.

4. When the spring has been adjusted properly, tighten the lock nut on the plug and lock with safety wire.

(e) TESTS BEFORE INSTALLATION.—Refer to figure 432 for fluid leak tests of the wing flap relief valve.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—Be sure all parts are clean before assembly. Refer to figure 432 when assembling the wing flap relief valve.

2. INSTALLATION.—To install the wing flap relief valve reverse the removal procedure and refer to figure 433.

(g) MAJOR OVERHAUL.

1. Remove and disassemble the wing flap relief valve in accordance with preceding instructions. Be sure all parts are clean before making any repairs.

2. Inspect all parts for wear and scratches. Refer to figure 434 for rework tolerances. If the parts cannot be repaired, install new parts.

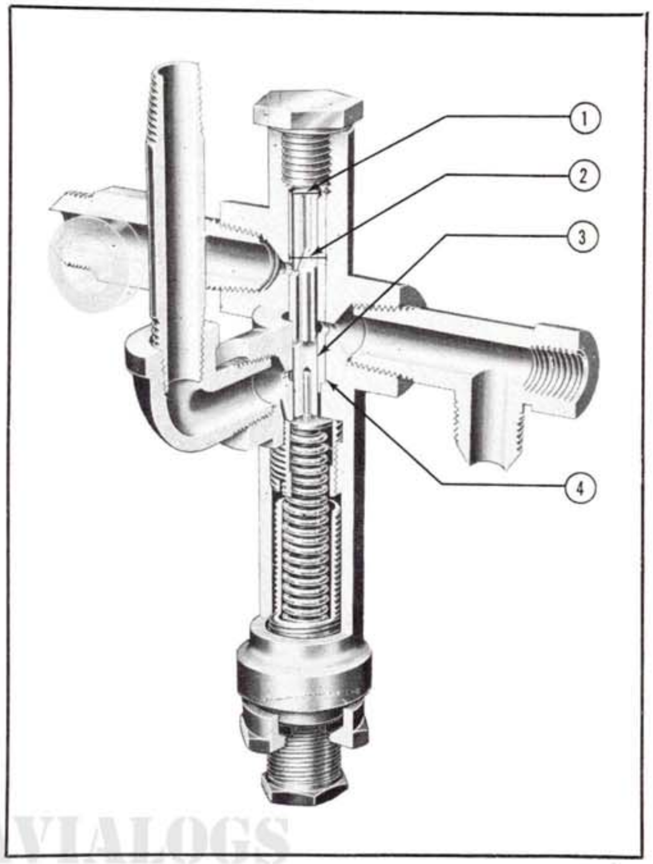


Figure 434—Rework Tolerances of Wing Flap Relief Valve

14,471

1. Manufacturing dimension .251 to .252 OD.
2. Manufacturing dimension .344 to .345 OD.
3. If diametral clearance between sleeve and piston exceeds .0010, rework by honing sleeve and installing oversize piston.
4. There must be a press fit between sleeve and body. Outside diameter of sleeve may be hard chrome plated.

3. Replace all gaskets with new parts.

4. When repairs have been completed, assemble the wing flap relief valve and test for fluid leaks as outlined in figure 432.

(5) ORIFICE CHECK VALVE.

(a) DESCRIPTION.—The orifice check valve, which is a conventional check valve with a hole drilled through the spring-loaded valve poppet, is installed in the wing flaps DOWN line and is located under the floor of the right-hand baggage compartment. (See figure 424. The orifice check valve allows unrestricted flow of fluid when the wing flaps are lowered. When the wing flaps are raised the orifice check valve restricts the return flow of fluid in the DOWN line from the actuating cylinder. This restriction of the flow of return fluid causes a time lag and prevents rapid raising of the wing flaps and consequent sudden loss of lift in flight.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Remove the flooring in the right-hand baggage compartment to gain access to the orifice check valve.

b. Disconnect and cap the two lines leading to the valve and remove the valve from the airplane.

2. DISASSEMBLY.—To disassemble the orifice check valve, unscrew the end fitting and remove the spring and poppet.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the orifice check valve is damaged or is not functioning properly, replace it with a new part.

(d) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the orifice check valve, reverse the disassembly procedure.

2. INSTALLATION.—To install the orifice check valve reverse the removal procedure.

(e) MAJOR OVERHAUL.

1. Remove and disassemble the orifice check valve, following preceding instructions.

2. Inspect the poppet for wear and replace with a new part if necessary. Make certain the hole in the poppet is not clogged. If a new steel poppet is installed, lap to seat with extra-fine grinding compound. It is not necessary to lap plastic poppets.

3. If the spring is damaged replace with a new part. Install a new gasket, and assemble the valve.

(6) WING FLAP INDICATING SYSTEM.
(See figure 424.)

(a) DESCRIPTION.—The wing flap indicating system consists of a flexible steel wire sheathed in a steel tube assembly with one end of the wire connected to the forward end of the wing flap actuating cylinder and the other end connected to an indicator mounted on the bottom of the pilot's instrument panel (figure 431). Any movement of the wing flap actuating cylinder is shown by an equivalent movement of the pointer on the indicator, indicating directly the position of the wing flaps. The tube assembly is attached to the airplane with bonded clips.

(b) REMOVAL.

1. Disassemble the indicator pointer from the wire.

2. Remove the access cover plate on the bottom of the center wing to gain access to the wing flap actuating cylinder. Disconnect the clevis from the actuating cylinder cap.

3. The flap indicator wire then may be pulled out of the tube assembly through the access opening.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—The wing flap indicator requires no maintenance except periodic lubrication and occasional inspection to determine that all connections are secure. The flap indicator housing tube should be lubricated every 100 hours with oil, Specification No. AN-O-6, at the lubrication fitting on the left side of the pilot's compartment. Coat the indicator wire in the indicator tube adjacent to the wing flap actuating cylinder every 100 hours with grease, Specification No. AAF 3607.

(d) ADJUSTMENTS.—The wing flap position indicator wire may be adjusted by means of the clevis which is attached to the wing flap actuating cylinder. Adjust the wing flap indicator for proper travel with the wing flaps down by lengthening or shortening the clevis.

(e) INSTALLATION.—To install the wing flap indicator wire reverse the removal procedure.

KEY TO FIGURE 435

1. Brake Control Valve
2. Windshield Wiper Control
3. Windshield Wiper Motor Control
4. L. H. Cable Control Assembly
5. Window Control Assembly
6. Windshield Wiper Blade
7. Hydraulic System Pressure Relief Valve
8. Hydraulic System Pressure Accumulator
9. Hydraulic System Fluid Reservoir
10. Hydraulic System Pressure Regulator
11. Engine-Driven Hydraulic Pump Selector Valve
12. Hydraulic Control Panel
13. Nonram Carburetor Air Filter Control Valve
14. Nonram Carburetor Air Filter Operating Mechanism
15. Hydraulic Hand Pump
16. Nonram Carburetor Air Filter Actuating Cylinder
17. Nonram Carburetor Air Filter Unit

KEY TO FIGURE 435A

1. Brake control valve
2. Windshield wiper control valves
3. Windshield wiper motors
4. Hydraulic system hand pump
5. Hydraulic system filter
6. Hydraulic system pressure accumulator
7. Hydraulic system reservoir
8. Hydraulic system check valve
9. Hydraulic system pressure relief valve
10. Hydraulic system pressure regulator
11. Engine-Driven pump selector valve
12. Blower control valve
13. Blower control actuating cylinder

g. WINDSHIELD-WIPER HYDRAULIC SYSTEM. *(See figure 435.)*

(1) GENERAL. — Hydraulically actuated windshield wipers are provided on the pilots' windshields for use in rainy weather. When icing conditions exist the windshield wipers are operated in conjunction with the windshield anti-icing system. Hydraulic fluid pressure for the windshield wipers is obtained from a cross in the brake pressure line. The fluid flows, on early airplanes, through a tube to the windshield wiper control valve (figure 435) which is located on the left side of the pilots' main instrument panel and on later airplanes the fluid flows through a tube to two windshield wiper control valves which are located just above and in the center of the pilots' main instrument panel. These valves control the operating speed of the wiper blades. The hydraulic fluid flows from the control valves to the wiper motors (figure 436). The returning fluid from the windshield wiper motor flows to a cross in the brake return line and returns to the hydraulic

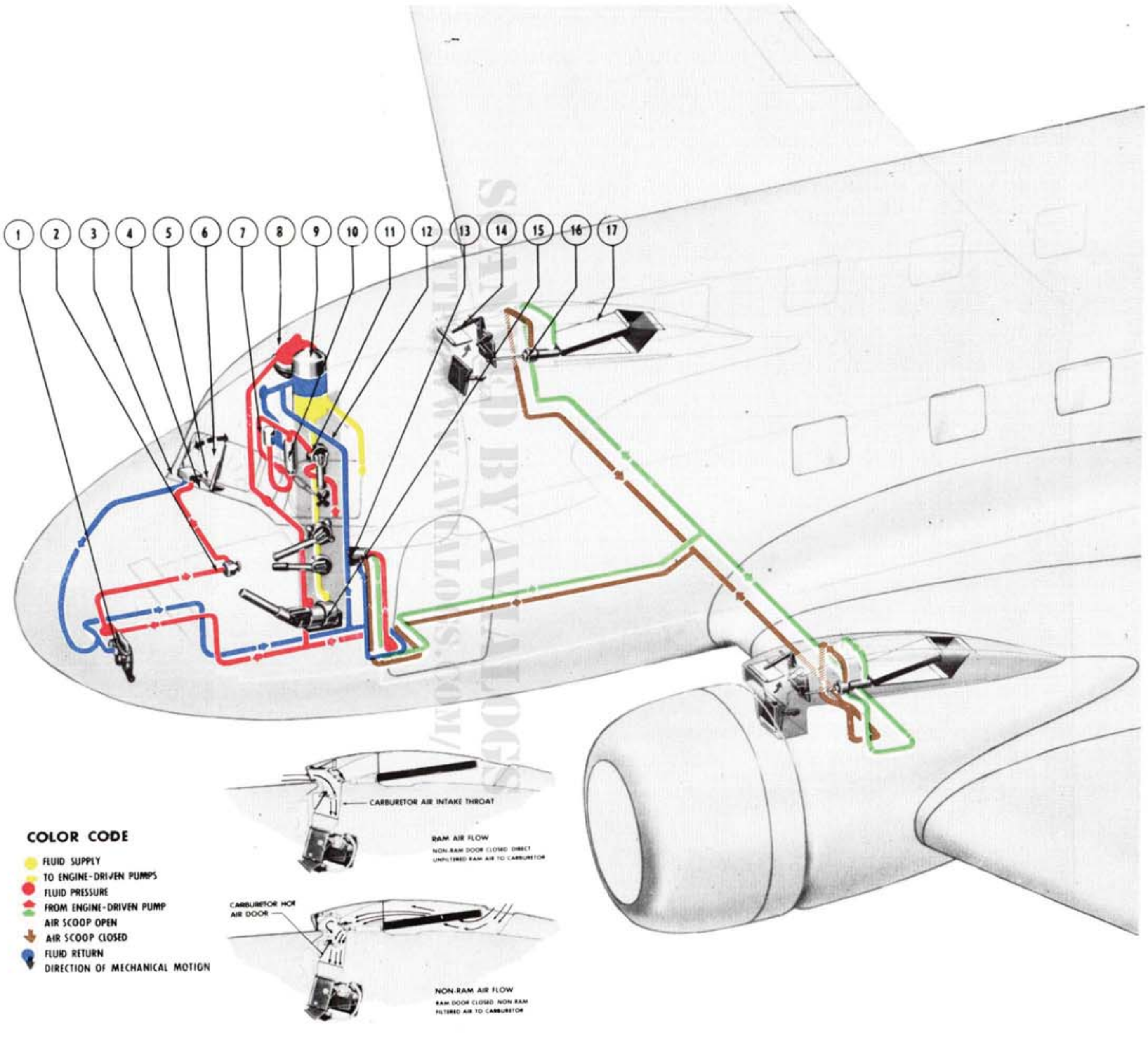

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
COLOR CODE
FLUID SUPPLY
TO ENGINE-DRIVEN PUMPS
FLUID PRESSURE
FROM ENGINE-DRIVEN PUMP
AIR SCOOP OPEN
AIR SCOOP CLOSED
FLUID RETURN
DIRECTION OF MECHANICAL MOTION
CARBURETOR AIR INTAKE THROAT
RAM AIR FLOW
NON-RAM DOOR CLOSED DIRECT UNFILTERED RAM AIR TO CARBURETOR
CARBURETOR HOT AIR DOOR
NON-RAM AIR FLOW
RAM DOOR CLOSED NON-RAM FILTERED AIR TO CARBURETOR

Figure 435—Nonram Carburetor Air Filter and Windshield-Wiper Hydraulic Systems

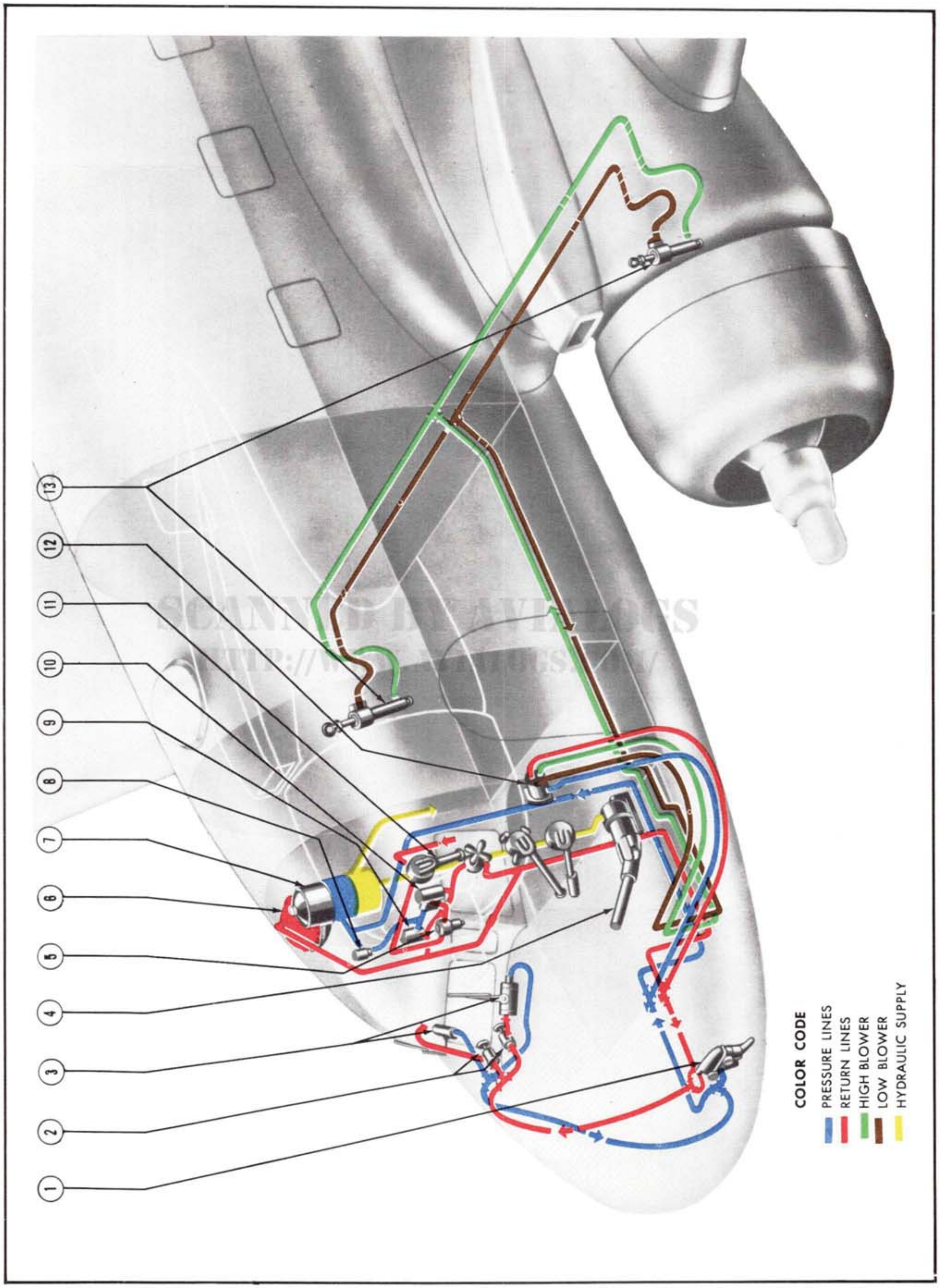

14,472
1
2
3
4
5
6
7
8
9
10
11
12
13
COLOR CODE
🟦 PRESSURE LINES
🟥 RETURN LINES
🟩 HIGH BLOWER
🟫 LOW BLOWER
🟨 HYDRAULIC SUPPLY

Figure 435A—Blower Control and Windshield-Wiper Hydraulic Systems—Late C-47B Airplanes

reservoir. NEVER OPERATE the windshield wipers on dry glass because of the friction which might cause unnecessary wear on the wiper blades and windshield glass. To start either wiper, slowly open its control valve until the desired speed of the wiper blade is obtained. If icing conditions exist, the wiper blades should be started immediately and alcohol applied by opening the windshield anti-icing control valve (figure 436) before a layer of ice has formed on the windshield. The condition of the windshield glass will be the best guide for the frequency of alcohol application. Stop the windshield wiper with the blades pointing in their most forward position.

(2) WINDSHIELD WIPER CONTROL VALVE.

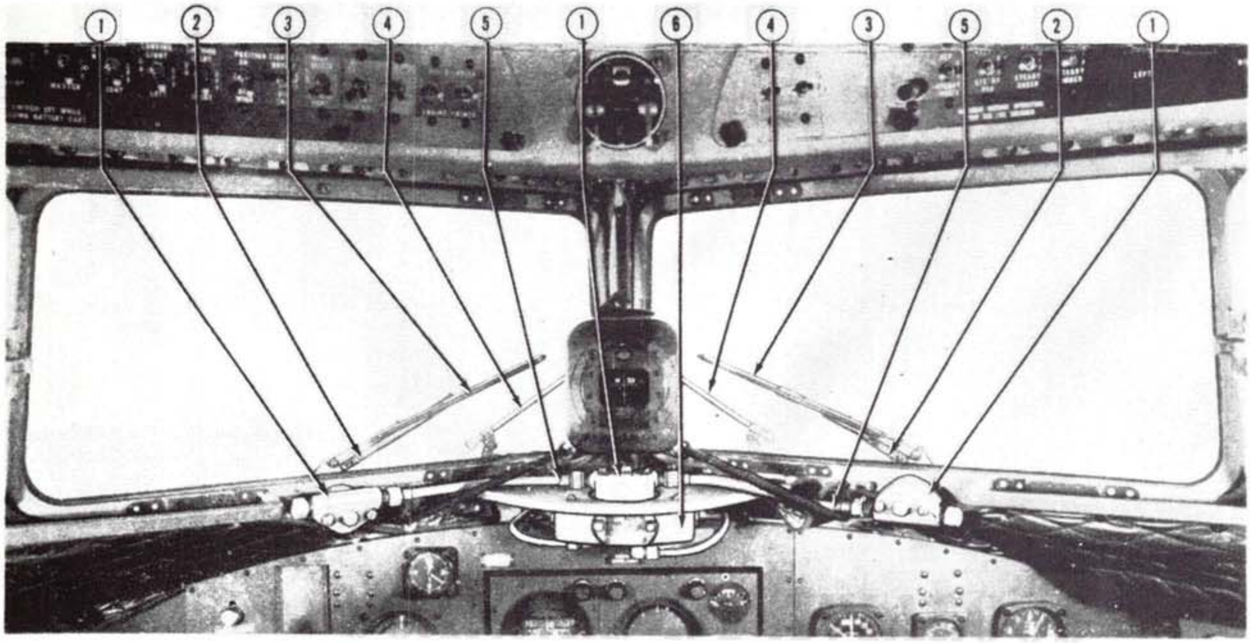


Figure 436—Windshield Wipers Installed—C-47A and Early C-47B Airplanes

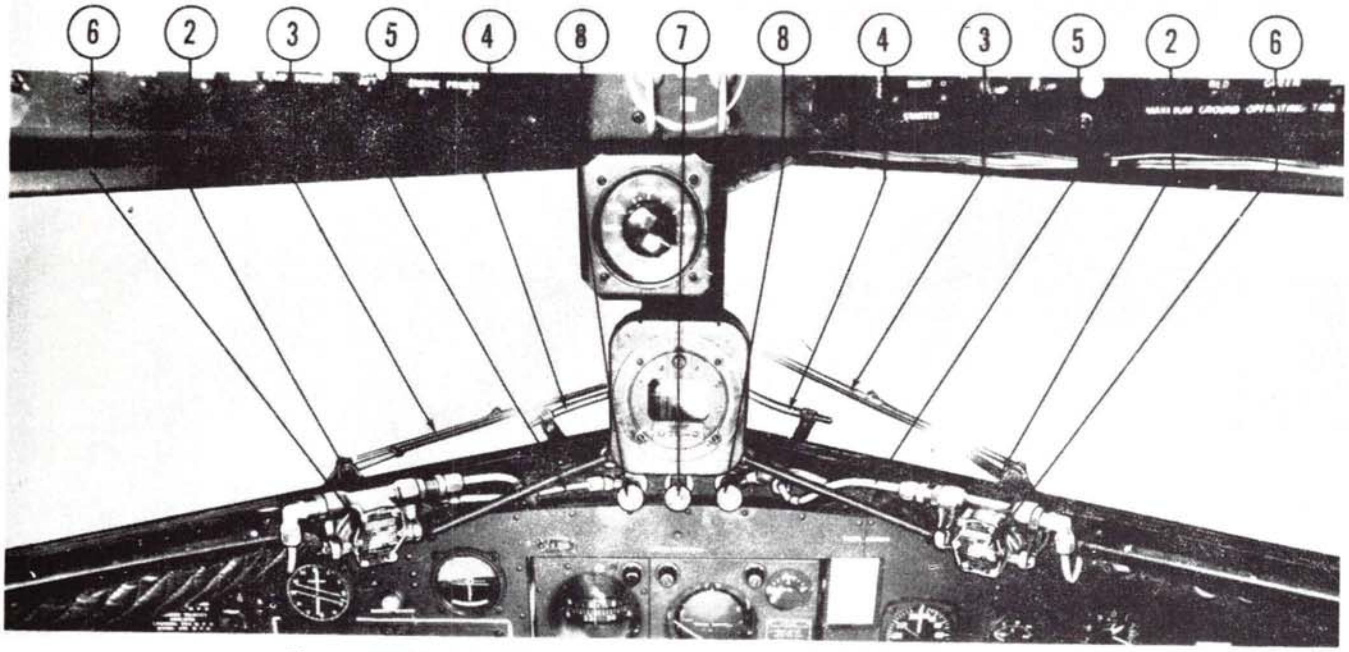


Figure 436A—Windshield Wipers Installed—Late C-47B Airplanes

KEY TO FIGURE 436 AND 436A

1. Wiper Control Units
2. Wiper Operating Arms
3. Wiper Blades
4. Anti-Icing Tubes
5. Flexible Shaft Housings
6. Wiper Motor
7. Windshield Anti-Icing Control Valve
8. Windshield Wiper Control Valve

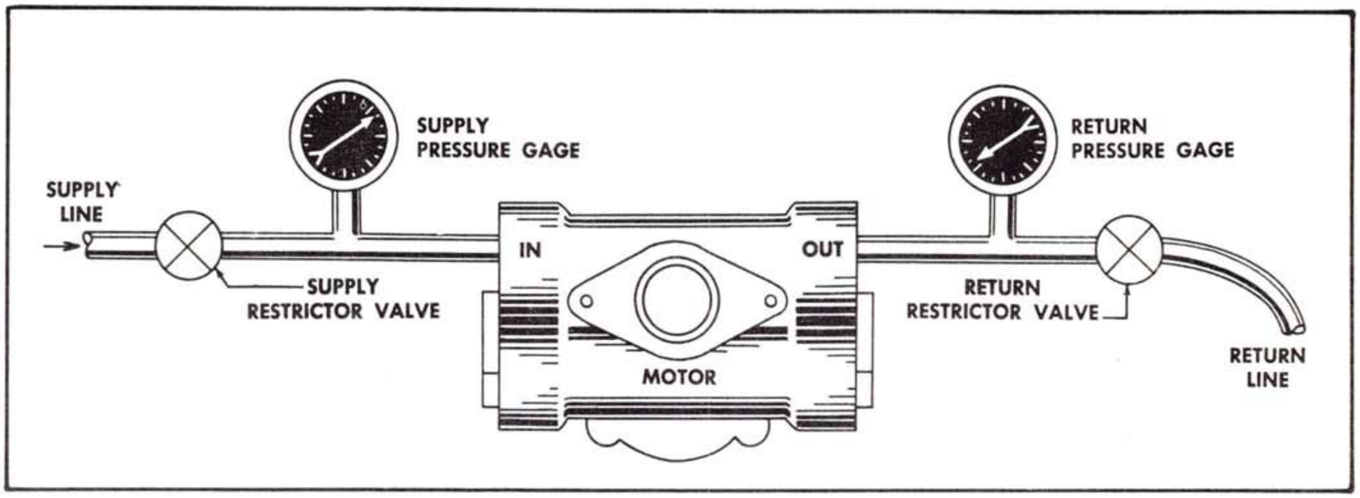

SUPPLY PRESSURE GAGE
RETURN PRESSURE GAGE
SUPPLY LINE
IN
OUT
SUPPLY RESTRICTOR VALVE
RETURN RESTRICTOR VALVE
MOTOR
RETURN LINE

Figure 436B—Test Procedure for Windshield Wiper Motor

(a) DESCRIPTION. — The windshield-wiper control valve is a needle-type valve that controls the quantity of hydraulic fluid that flows to the windshield-wiper motor and consequently controls the speed of the windshield wipers. The control valve is provided with an orifice which prevents overspeeding of the wiper motor and the wipers never should be operated with the orifice removed from the control valve.

(b) REMOVAL.

1. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

2. Disconnect and cap the hydraulic lines leading to the control valves.

3. Remove the nuts that attach the control valves and remove the valves from the airplane.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. Fluid leakage at the control valve knob may be remedied by moderate tightening of the valve packing nut or replacing of packing.

2. If the windshield-wiper control valve is damaged or is not functioning properly, replace it with a new part.

Note

If wipers have a tendency to creep, this may be remedied by lapping the valve seat with a lapping tool.

(d) INSTALLATION. — To install the windshield-wiper control valve, reverse the removal procedure.

(3) WINDSHIELD-WIPER ACTUATING UNITS.

(a) C-47A and Early C-47B Airplanes.

1. DESCRIPTION. — The windshield-wiper drive assembly consists of the hydraulic motor and motor control which are coupled to the two window control assemblies by two cable control assemblies. The wiper blades and operating arms are mounted on the splined shafts of the window controls units. (See figure 437.) The hydraulic fluid under pressure enters the hydraulic motor and is directed against the actuating piston by means of two, two-way valves. These two-way valves reciprocate the oil flow from one end of the actuating piston to the other by means of toggle arms, a cam, and a spring. The geared piston controls the pinion which in turn controls the wiper-arm actuating shaft. The motion of the actuating piston is transmitted to the window control assemblies by the flexible push-pull cable control assemblies.

(b) LATE C-47B AIRPLANES.

1. DESCRIPTION.—The actuating units consist of an individual motor for each wiper blade. The motor operates the blade by means of a shaft protruding from the front. Power for the blades comes from a piston inside the motor. This piston is double ended and has a gear rack in the center which acts on a pinion

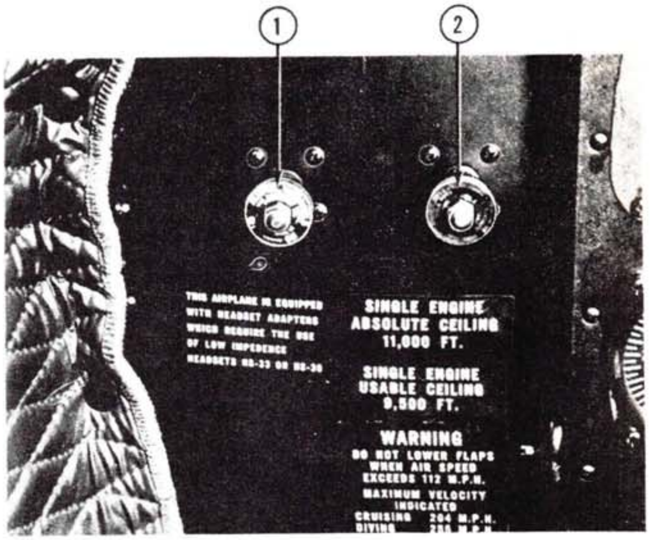

①
②
THIS AIRPLANE IS EQUIPPED WITH HEADSET ADAPTERS WHICH REQUIRE THE USE OF LOW IMPEDENCE HEADSETS HS-33 OR HS-38
SINGLE ENGINE ABSOLUTE CEILING 11,000 FT.
SINGLE ENGINE USABLE CEILING 9,500 FT.
WARNING
DO NOT LOWER FLAPS WHEN AIR SPEED EXCEEDS 112 M.P.H.
MAXIMUM VELOCITY INDICATED
CRUISING 204 M.P.H.
DIVING

Figure 437—Windshield-Wiper Control Valve Installed—Early Airplanes

1. Windshield Anti-Icing Control Valve
2. Windshield Wiper Control valve

on the blade shaft, causing blade action. Reciprocating action of the piston is accomplished by hydraulic oil under pressure controlled through the use of two two-way valves operated by and synchronized with the blade shaft. Control of the two valves is accomplished by means of toggle arms, cams and springs.

(c) REMOVAL.

1. REMOVAL AND DISASSEMBLY.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

b. Disconnect and cap the hydraulic lines leading to the hydraulic motors.

c. Remove the wiper blades and arm assemblies from the window control units or motor shafts.

d. Remove the hydraulic motors.

2. DISASSEMBLY.—LATE C-47B AIRPLANES.

a. Cut lock wire, remove the six screws and washers from back of motor.

b. Remove rear plate and gasket.

c. Remove set screw from front of motor and unscrew large retaining nut and washer.

d. Pull out shaft assembly.

e. Remove static seal and shaft bearing assembly from shaft.

f. On shaft bearing assembly unscrew packing nut and remove shaft packing.

g. Cut the lockwire, remove the two large plugs and gaskets from each side of motor.

h. Push piston assembly out of cylinder.

i. Unscrew the plugs from both ends of the piston assembly and remove the packings, balls and spring.

j. Remove the two springs and heart-shaped link from the back of the motor.

k. Remove the two small plugs and gaskets on each side of the motor.

l. Carefully remove the valve pistons, valve cylinder sleeves and seals from ports just opened.

m. Remove valve pusher, cams, and toggle plate from the back of motor.

(d) MAINTENANCE REPAIR OR REPLACEMENT.

1. Inspect the motors and hydraulic lines for hydraulic fluid leaks. This should be done by operating the wiper blades very slowly.

CAUTION

Wet the windshield with a sponge saturated in water or by other similar means. Never operate the wiper blades on dry glass.

2. While the wiper blades are operating check to see that the blade pressure is constant over the entire range and that the distance from the blade to the lower windshield is approximately equal at both extremes. The wiper blade must not touch the lower frame of the windshield in either of its extreme positions. If it does, it indicates that the wiper arm is out of time with the drive motor.

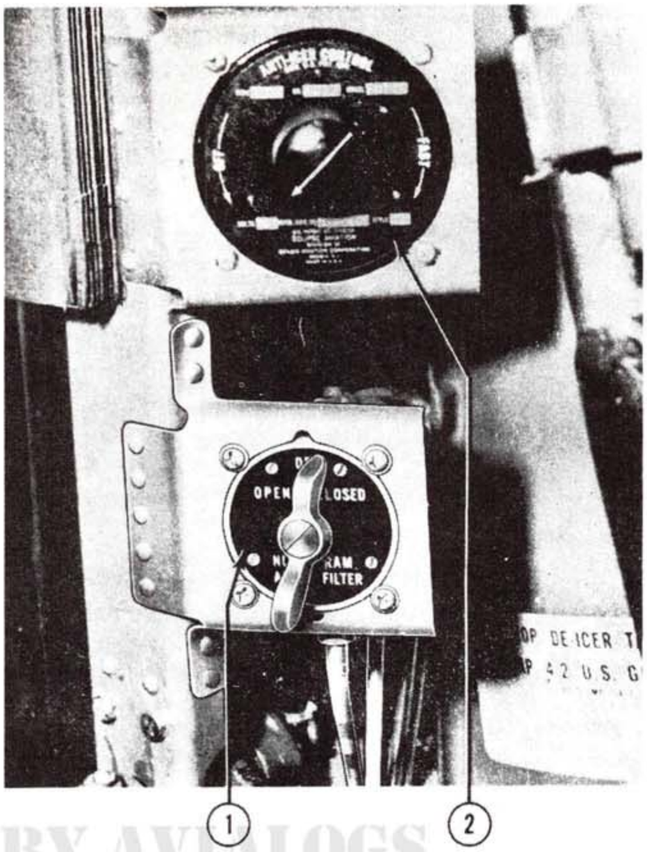


Figure 438—Nonram Carburetor Air-Filter Control Valve Installed

1. Nonram Carburetor Air-Filter Control Valve
2. Anti-Icer Rheostat

3. Turn off the control valve. If the wiper does not make a clean sweep throughout the full arc of operation, inspect the wiper blades for damage and deterioration. Test the spring tension of the blades with a spring scale. Lift the blades with the scale hooked under the wiper arm at the center portion of the wiper blade. Lift up until the blade barely leaves the windshield. The spring scale should indicate 32 ounces. The spring tension can be adjusted by means of the screw at the base of the wiper-arm assembly.

(e) ASSEMBLY AND INSTALLATION.—Assembly of motor is the reverse of the disassembly procedure except as follows:

1. Shaft is installed and timed with toggle plate and piston rack before installing shaft bearing assembly and static seal on bearing shaft.

2. To time shaft, first install piston rack, two large end plugs and gaskets. Slip shaft pinion partway on piston rack with marked teeth mating. Without allowing mating teeth to slip, turn shaft until piston bottoms in one end of cylinder. Turn toggle plate until its two pins are square with the motor and on the same side of the symmetrical center line of the motor as the piston. Slip shaft all the way into motor, engaging serrations on end of shaft with hole in toggle plate. Check timing by rotating shaft to both extremes of travel. Toggle plate should stop at each end of stroke with its two pins on a line square with center line of the motor.

(f) FINAL TEST AFTER ASSEMBLY.

1. OPERATION AND LOW-PRESSURE TEST: Mount the motor rigidly on the test stand and set up the test equipment as shown in figure 436B. Open the return line restrictor wide. Then open the supply line restrictor valve slowly until the motor starts running. Adjust both restrictor valves until the supply pressure is 120 psi and the return pressure is 30 to 50 psi. Operate unit for five minutes under these conditions. Check for proper operation and for external leaks at all plugs, seals, or through the casting.

2. HIGH-PRESSURE STATIC TEST: Open the return line restrictor wide. Lock the shaft at its extreme clockwise travel. Open the supply line restrictor until the internal pressure relief valve in the motor opens, which should occur somewhere near 700 psi to 1000 psi. Then let supply pressure drop to 700 psi and check all plugs on the left side of the motor for leaks. Lock the shaft at its extreme counter-clockwise travel and repeat test as above for external leaks past plugs on right side of motor. Allowable external leakage for all tests is one drop in 48 hours.

(g) MAJOR OVERHAUL.

1. Remove and disassemble in accordance with preceding instruction.

2. Check all moving parts for damage or wear and make necessary replacement.

3. Ball seals that are slightly worn may be lapped.

4. Replace all seals and gaskets.

5. Reassemble and time in accordance with the procedure preceding.

b. NON-RAM CARBURETOR AIR-FILTER AND TWO-SPEED BLOWER CONTROL HYDRAULIC SYSTEMS.

(See figures 435 and 435A.)

(1) NON-RAM CARBURETOR AIR FILTER HYDRAULIC SYSTEM.—The non-ram carburetor air-filter mechanism, which controls flow of air through the

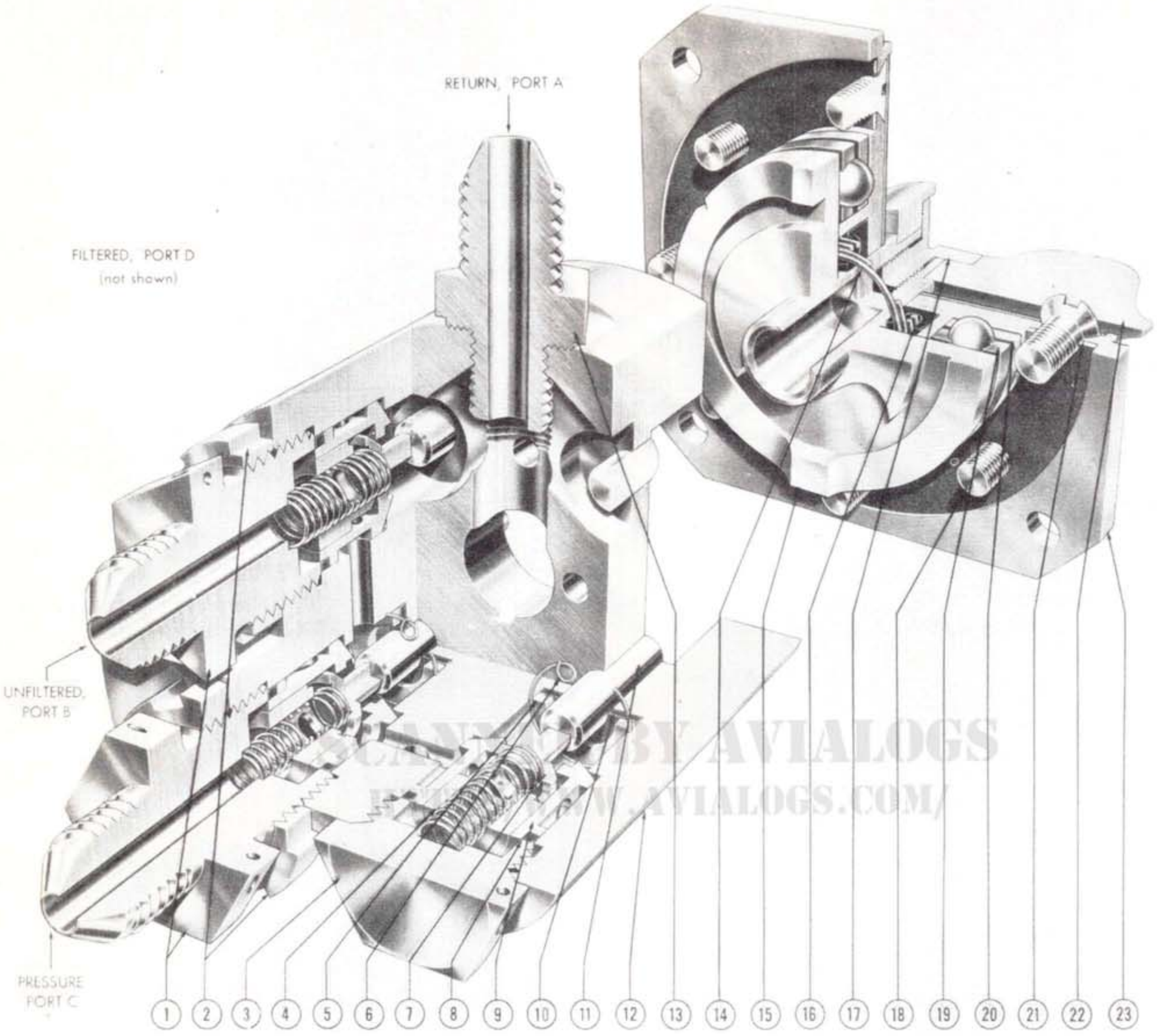

RETURN, PORT A
FILTERED, PORT D
(not shown)
UNFILTERED, PORT B
PRESSURE PORT C
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

Figure 439—Nonram Carburetor Air-Filter Control Valve Assembly

Douglas Dwg. No. 4141612, Adel No. D-11616

TEST PROCEDURE

Test Port	*Ports Plugged*	*Handle Position Viewed from Top*	*Test Press.*	*Max. Leakage*
C	None	Neutral	1500 lb/sq in.	EXTERNAL—None INTERNAL—10 drops per hour
C	D	Counter-clockwise	1000 lb/sq in.	EXTERNAL—None INTERNAL—10 drops per hour
C	B	Clockwise	1000 lb/sq in.	EXTERNAL—None INTERNAL—10 drops per hour
A	B, C, & D	Any position	125 lb/sq in.	EXTERNAL—None INTERNAL—10 drops per hour

carburetor air scoop, is operated by a small hydraulic actuating cylinder mounted on the left side of the air-scoop structure forward of the fire wall. The actuating cylinder is controlled by a four-way control valve mounted on a bracket directly behind the pilots' seat. (See figure 438.) The pressure and return lines for the non-ram carburetor air-filter hydraulic system are connected to the brake pressure and return lines immediately below the hydraulic control panel. When the control valve handle is moved to the "CLOSED" (unfiltered) position the actuating cylinder piston extends, opening the door in entrance to the ram air scoop and closing the aft butterfly door in the non-ram air scoop. Air under ram pressure is then supplied to the carburetor. When the control valve handle is moved to the "OPEN" (filtered) position, the actuating cylinder piston retracts, closing the door in the entrance to the ram air scoop and opening the aft butterfly door in the non-ram air scoop. Air to the carburetor then flows into the non-ram scoop and through the air-filter unit in the aft section of the scoop. (See figure 217.) After the completion of an operation of the non-ram air-scoop mechanism, immediately turn the control valve handle to the "OFF" (lock) position to relieve the pressure in hydraulic operating lines to the actuating cylinder.

Note

When carburetor heat is applied be sure the non-ram carburetor air-filter control valve handle is in the "OPEN" (filtered) position so that the flow of ram air is blocked. Maximum carburetor heat rise is obtained when the carburetor air is flowing through the non-ram scoop.

KEY TO FIGURE 439—Continued

1	Unions
2	Lock Nuts
3	Retaining Plug
4	Poppet Spring
5	Spacer
6	Snap Ring
7	Poppet
8	Gasket
9	Poppet Seat
10	Push Rod Packing
11	Push Rod
12	Valve Body
13	Return Port Fitting
14	Spring
15	Camshaft
16	Packing Cup
17	Handle Retaining Screw
18	Cover Retaining Screw
19	Camshaft Bearing
20	Bearing Plate
21	Cover Gasket
22	Handle
23	Cover

(2) NON-RAM CARBURETOR AIR-FILTER CONTROL VALVE. *(See figure 439.)*

(a) DESCRIPTION.—The non-ram carburetor air-filter control valve is a four-way poppet-type valve to control the flow of hydraulic fluid to the actuating cylinder. The steel poppets are spring loaded and are opened by steel pins, which are depressed in the proper combinations by the cam rotor in the valve head. The valve handle is connected to the cam rotor. The control valve is mounted on a bracket located directly behind the pilot's seat. The control valve has three positions: "OPEN" (filtered), "CLOSED" (unfiltered), and "OFF" (lock) as previously explained. A built-in stop limits handle movement to 90 degrees.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "ZERO."

b. Disconnect and cap the hydraulic lines leading to the non-ram air-filter control valve.

c. Remove the screws that attach the control valve to the mounting bracket and remove the valve from the airplane.

2. DISASSEMBLY.—Disassembly of the control valve should not be attempted in the field. When disassembly is attempted refer to figure 436 and observe the following instructions:

a. With the name plate up, remove the handle.

b. Remove the screws that attach the name plate to the valve.

c. Remove the screws that attach the valve cover to the valve body. Remove the cover and cam rotor assembly. Remove the steel pins.

d. Remove the fittings at the opposite end of the valve body and remove the springs and poppets.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the non-ram carburetor air-filter control valve is damaged or is not functioning properly, replace it with a new or serviceable part.

(d) TESTS BEFORE INSTALLATION.—Refer to figure 439 for fluid leak tests of the non-ram carburetor air-filter control valve.

(e) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the non-ram carburetor air-filter control valve, refer to figure 439 and reverse the disassembly procedure.

2. INSTALLATION.—To install the control valve, reverse the removal procedure.

(f) MAJOR OVERHAUL.

1. Remove and disassemble the non-ram carburetor air-filter control valve as previously instructed.

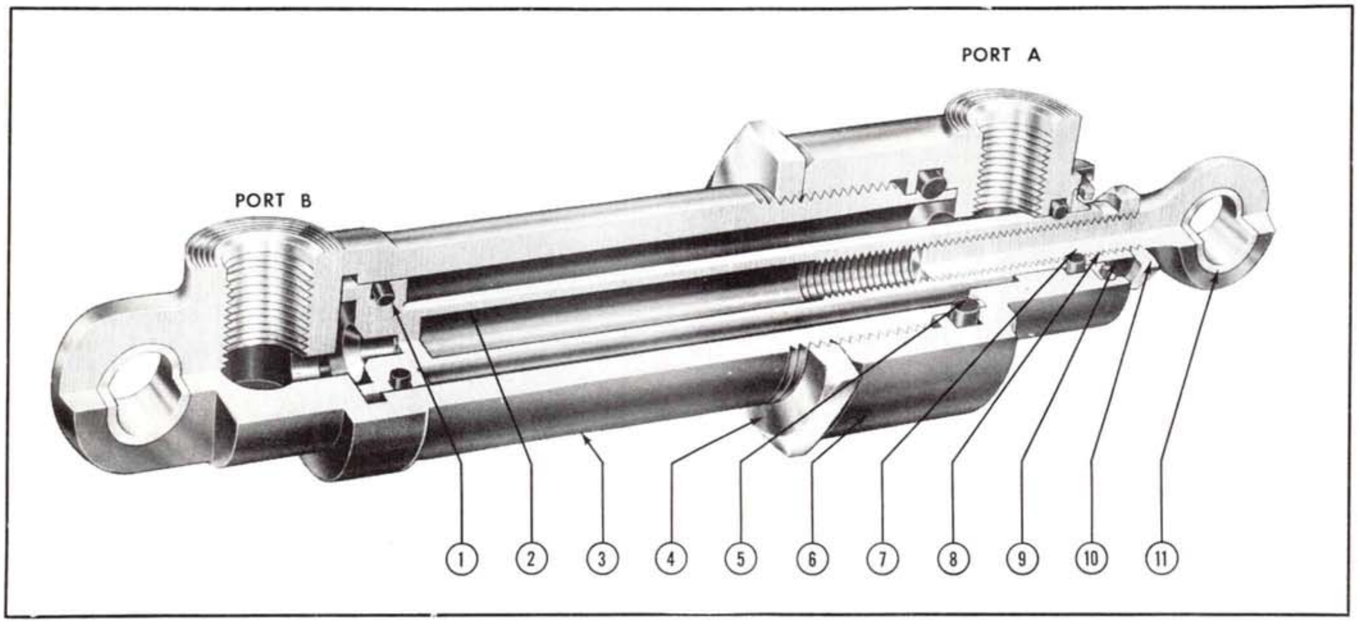


Figure 440—Nonram Carburetor Air-Filter Actuating Cylinder Assembly

(Douglas Dwg. No. 2203170, Adel Precision Products Corp. No. B-10666)

TEST PROCEDURE

Test Port	*Piston Position*	*Test Pressure*	*Max. Leakage*
A	Retract	1350 psi	2 drops in 12 hours external 10 drops per hour internal
B	Extend	1350 psi	2 drops in 12 hours external 10 drops per hour internal

Packing Friction at A and B—40 psi maximum.

1	AN6227-11 Packing
2	Piston
3	Cylinder
4	Lock Nut
5	AN6227-17 Packing
6	Cylinder Head
7	AN6227-8 Packing
8	Scraper
9	Snap Ring
10	AN316-4R Lock Nut
11	Piston Rod End Fitting

Note

Douglas Part No. 2203170 includes Adel No. B-10666 cylinder assembly, 2-Parker 3175-3-4D unions, and 2-Parker 3175-2-4D gaskets.

2. Inspect all parts for wear, pitting, and corrosion; make necessary replacements with new parts.

3. If the poppets and seats are only slightly worn, they may be reconditioned by lapping with extra-fine grinding compound. Insert a tube or piece of soft wood into the poppet to hold the poppet while lapping. When a satisfactory seat has been obtained, remove all traces of the grinding compound by washing the parts in clear gasoline.

4. Install new gaskets and seals.

5. Reassemble the valve and test for fluid leaks as instructed in figure 439.

(3) NON-RAM CARBURETOR AIR-FILTER ACTUATING CYLINDER.

(See figure 440.)

(a) DESCRIPTION. — The non-ram carburetor air-filter actuating cylinder is mounted on a bracket inside and on the left side of the air scoop forward of the fire wall with the piston rod attached to the series of rods and levers that operate the doors in the air scoop. The actuating cylinder has two ports to connect to the operating lines. The operation of the actuating cylinder is explained in paragraph 13.*b*.(1).

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic pressure gage indicates "zero."

b. Remove the two access doors on the left side of the air scoop and forward of the fire wall.

c. Remove the cotters and remove the two bolts that attach the non-ram carburetor air-filter actuating cylinder. Remove the actuating cylinder from the airplane.

2. DISASSEMBLY.—Do not attempt to disassemble the actuating cylinder in the field. When the cylinder is disassembled, refer to figure 440. Do not clamp the cylinder barrel in a vise during disassembly but use a wooden clamp as described in this paragraph 13.*c.*(3)*(b)2.*

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the non-ram carburetor air-filter actuating cylinder is damaged or is not functioning properly, install a new or serviceable part.

(d) ADJUSTMENTS.—To adjust the non-ram carburetor air-filter actuating cylinder with the operating mechanism, refer to paragraph 6.*c.*(1), this section.

(e) TESTS BEFORE INSTALLATION.—Refer to figure 440 for fluid leak tests of the non-ram carburetor air-filter actuating cylinder.

(f) ASSEMBLY AND INSTALLATION.

1. ASSEMBLY.—To assemble the actuating cylinder, refer to figure 440. Use care when installing the packing to prevent cutting or shearing the packing.

2. INSTALLATION.—To install the actuating cylinder, reverse the removal procedure.

(g) MAJOR OVERHAUL.

1. Remove and disassemble the non-ram carburetor air-filter actuating cylinder as previously instructed.

2. Inspect all wearing surfaces for scratches and abrasions. Slight scratches and abrasions on the cylinder walls, piston and piston rod may be honed out carefully. If long, deep scratches are found, new parts must be installed.

3. Replace all packing with new parts.

4. Inspect the bushings in the cylinder and piston rod for wear and make necessary replacements with new parts.

5. Inspect the remaining parts for wear and general condition; replace with new parts if necessary.

6. Reassemble the actuating cylinder and test for fluid leaks as specified in figure 440.

(4) BLOWER CONTROL HYDRAULIC SYSTEM.—On C-47B airplanes, the blower clutch selector valve (see Section IV, 6.*b.*(9)) is actuated by a small hydraulic cylinder located on the left-hand side of the intermediate rear crankcase. A cutaway view of the cylinder appears in figure 440C. A view of the cylinder, installed, is in figure 213C. This cylinder is actuated by pressure from the main hydraulic system. The "blower control" is a small hydraulic selector valve which controls the action of the cylinder. This valve is located in the cockpit, to the left of the pilot. (See figure 213D.) Operation of the blower control should be restricted to the "HIGH" and "LOW" positions only, and the change should be made without hesitation between positions. An electrical indicator system is also incorporated with this control. When operating properly, the indicator lights (2 and 3, figure 213D), go on when the blower control is in "HIGH" position. Failure of one or both of these lights to glow when the blower control is in "HIGH" position is a warning that the hydraulic control system may not be operating properly. Lines for hydraulic pressure and return connect into the hydraulic brake lines just forward of the right-hand fuselage connector plate located between stations 49⅛ and 63. These lines cross the fuselage beneath the flooring and run up to the blower control located to the left of the pilot. Two more lines, one each for "HIGH" and "LOW" blower, run from the blower control, through the right-hand fuselage tunnel and back to the center wing. There they tee into lines running into the accessory cowling of each engine, where they are connected to the actuating cylinders by means of flex lines.

(5) BLOWER CONTROL SELECTOR VALVE.

(a) DESCRIPTION.—Two types of blower control selector valves are used on C-47B airplanes. They are interchangeable on most airplanes, but some have brackets which will not take the Adel valve described immediately following. Both types of valves have the same general operation characteristics. Both are poppet-type valves which effectively control the flow of the hydraulic fluid to the cylinder.

CAUTION

> The operation of both types of selector valves should be limited to the "HIGH" and "LOW" positions only. This applies to both *flight and ground operations*. It is necessary to point out that the valve should never be left in a position midway between "HIGH" and "LOW," as the internal leakage of both types of valves may allow the hydraulic cylinder to retract. This will engage both blower clutches at the same time, causing them to burn up.

1. DOUGLAS NO. 4209833 (MADE FROM ADEL NO. D-11616 VALVE).—On some C-47B airplanes, the blower control valve is a Douglas No. 4209833 hydraulic selector valve reworked from the Adel No. D-11616 assembly used on the non-ram carburetor air filter hydraulic control valve described in *b.*(2), this paragraph, preceding. A cutaway view of this valve also appears in figure 439. For further information regarding the rework of this valve, see Douglas Drawing No. 4209833.

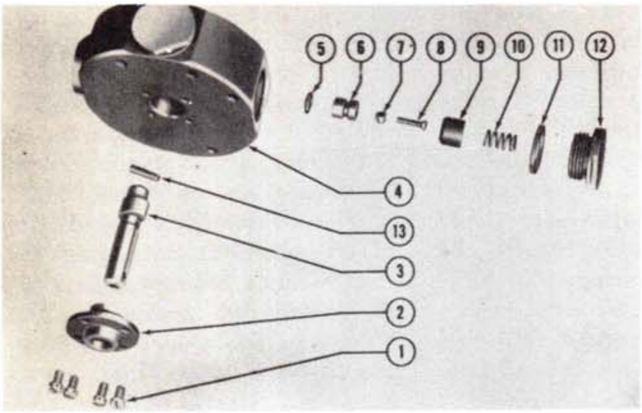


Figure 440A—Bendix 403656 Control Valve

Item	*Part Number*	*Name*	*No. Req.*
1	AAF 503-6-4	Screw	4
2	403702	Bendix Bearing	1
3	403697	Cam	1
4	403696	Body	1
5	AN6227-4	"O" Ring	4
6	404253	Piston	4
7	401193	Nut	4
8	4-40x½ Long	Steel Flathead Screw (Allen or Equiv.)	4
9	400636	Poppet	4
10	400644	Spring	4
11	AN902-8	Gasket	4
12	403661	Cap	4
13	403704	Pin	1

2. BENDIX NO. 403656 VALVE.—This valve is on late C-47B airplanes, and is also a spare part in place of the Adel type. This four-way selector valve (figure 440A) consists of four poppet elements set radially about an operating cam in an aluminum alloy body.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Operate the wing flaps until the hydraulic system pressure gage indicates "ZERO."

b. Disconnect and cap the hydraulic lines leading to the valve.

c. Remove screw that fastens control knob to the selector valve shaft and remove knob. On airplanes equipped with the Bendix valve, it will be necessary to remove a rivet before knob can be removed.

d. Remove the screws that attach the control valve to the mounting bracket and remove the valve from the airplane.

2. DISASSEMBLY.—Disassembly of either control valve should not be attempted in the field. When disassembly is attempted, see figure 439 and *h.*(2) this paragraph, preceding, if the valve is Adel type. If valve is Bendix type, the following instructions apply. No special tools required. See figure 440A.

a. Remove four caps (12, figure 440A) and take out spring and poppet (10 and 9, figure 440A).

b. Using long-nosed pliers, pull out the adjusting screw and piston (8 and 6, figure 440A).

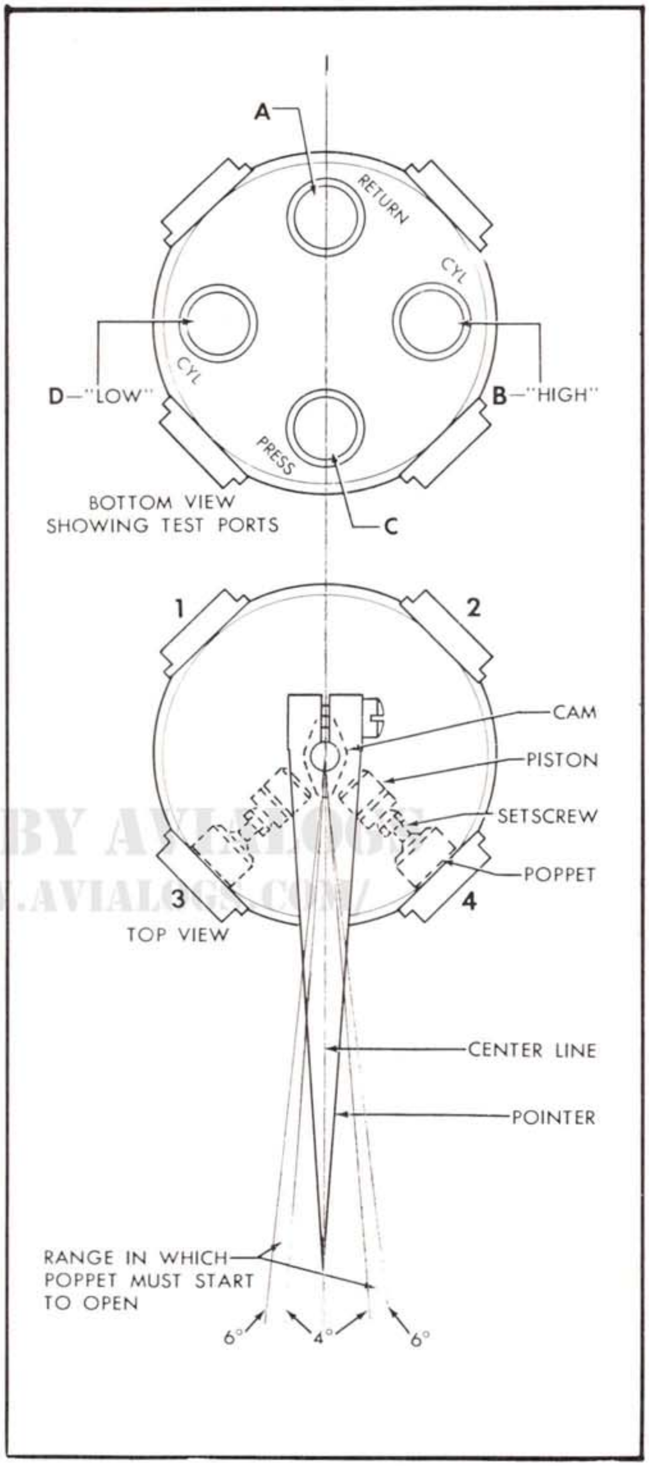


Figure 440B—Test Ports and Adjustment of Bendix 403656 Control Valve

c. Remove four screws (1, figure 440A) and take out bearing and cam (2 and 3, figure 440A). Do not lose pin (13, figure 440A).

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Maintenance of the Adel valve is given in 13.*h.*(2)*(c)*, this section, preceding. The following instructions apply only to the Bendix type 403656 valve. If this valve is damaged or is not functioning properly,

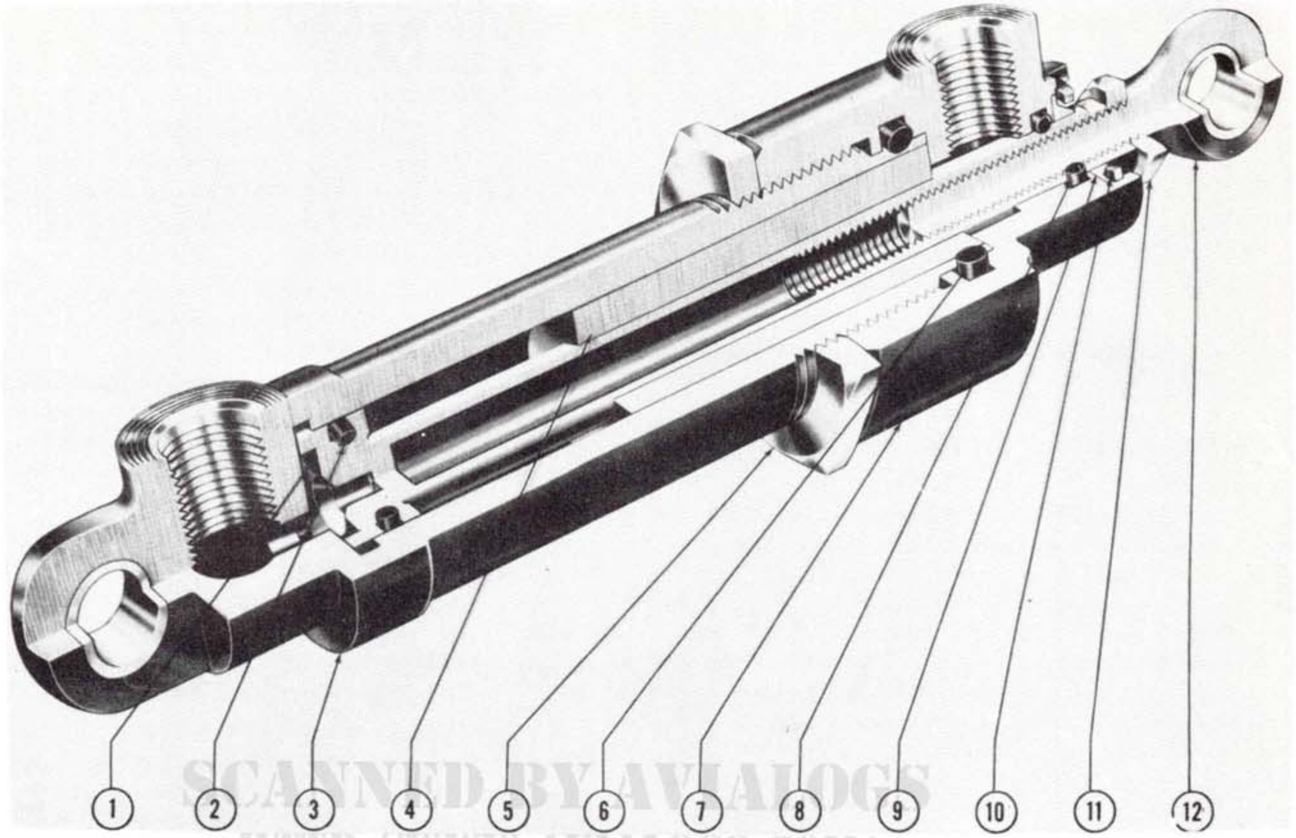


Figure 440C—Two-Speed Blower Control Actuating Cylinder

1. Piston
2. AN6227-11 Packing
3. Cylinder
4. Spacer
5. Lock Nut
6. AN6227-17 Packing
7. Cylinder Head
8. AN6227-8 Packing
9. Scraper
10. Snap Ring
11. AN316-4R Lock Nut
12. Piston Rod End Fitting

replace it with a new or serviceable part. Visually inspect the bearing holding the cam for leakage. Leakage at this point indicates that the inner packing on the pistons is leaking. The valve should be checked for operation at each regular inspection of the airplane to make certain that the valve is functioning properly. No other maintenance should be necessary. If it is impossible to obtain a new or serviceable part, disassemble the valve as in 13.*b.*(2)*(b),* this section, preceding. The following steps are then recommended:

1. Inspect the sealing surfaces in the body of the valve for scratches or evidence of wear. If worn or scored, replace with a new valve body.

2. Inspect the poppets for nicks or wear and replace these if worn or damaged. Inspect the poppet seats for nicks or scratches. Minor scratches may be lapped out with No. 900 lapping compound on a steel tool having the same shape as a poppet on the lapping end.

3. Inspect the cam for wear, especially the sides of the lobes which bear on the piston (3 and 6, figure 440A). If worn enough to prevent proper adjustment of the valve, reject the valve and replace with a new assembly.

4. Before reassembly, wash the body of the valve with an approved cleaning solvent and dry it with compressed air in order to clean out any foreign particles that may cause the valve to malfunction.

(d) ASSEMBLY.—For the assembly of the Adel type D-11616 valve, refer to figure 439 and to the text in *b.*(2)*(e),* this paragraph. For the assembly of the Bendix 403656 valve, the following steps are recommended:

1. Place the set screw in the piston and secure with the lock nut (8, 6, and 7, figure 440A).

2. Place the seal on the piston and push each piston into the chamber on the four sides of the body.

3. Replace the poppets and springs. Secure these with the seal and cap (9, 10, 11, and 12, figure 440A).

4. Place the pin into the slot in the cam (13 and 3, figure 440A).

5. Pack the cam chamber of the valve body (4, figure 440A) with low temperature lubricating grease, Specification No. MIL-G-3278.

6. Assemble the cam with its pin into the valve body (3, 13, and 4, figure 440A). Put the bearing

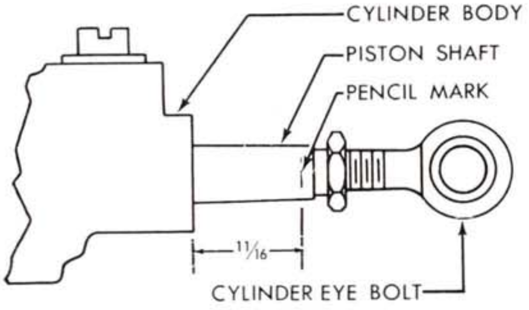


Figure 440D—Stroke of Piston Shaft, Blower Control Actuating Cylinder

into place and secure it with the four screws (2 and 1, figure 440A).

(e) ADJUSTMENT.—After reassembly the Bendix valve must be adjusted so that the poppets will have the correct lift when open. This is determined by the number of degrees each side of the neutral position that the cam must be turned before the poppets begin to open. The neutral position is an approximate center line intersecting the pressure and return ports. (See figure 440B). The poppets must start to open when the cam is turned not less than four degrees nor more than six degrees each side of this center line. During all of the following adjustment steps, refer to figure 440B.

1. Attach a pointer to the valve so that the pointer lines up with the 1/16 inch notch in the top of the cam. This notch indicates the center of the cam lobe.

2. Remove the caps, springs, and poppets of the two valve recesses 1 and 2, figure 440B.

3. Rotate the pointer to the left of the center line, so that the cam gently touches the piston of poppet 3, figure 440B.

4. If the cam does not touch the piston under 3, figure 440B, within six degrees to the left of the center line, the set screw 5, figure 440B, must be *lengthened.*

5. If the cam touches the piston under 3 in less than four degrees to the left of the center line, the set screw 5, figure 440B, must be shortened.

6. Repeat steps 3, 4, and 5, immediately preceding, for the adjustment of the valve under cap 4, figure 440B, except push the pointer to the *right* of the center line.

7. Replace poppets, springs, and caps under 1 and 2. Remove caps, springs, and poppets under 3 and 4.

8. Repeat steps 3, 4, and 5 for the adjustment of poppet 1 except push the pointer to the *right* of the center line.

9. Repeat steps 3, 4, and 5 for poppet 2 except push the pointer to the *left* of the center line.

10. Remove pointer and reassemble valve.

Note

Be sure that each poppet is re-installed in the recess it was removed from.

(f) TEST BEFORE INSTALLATION.—For the test procedure of both the Adel and Bendix valves, refer to figures 439 and 440B, and to 13.*h.*(2)*(d),* this section, preceding.

(g) INSTALLATION.—The installation procedure for both the Bendix and Adel valves is the same except for the handle.

1. Fasten the valve to the blower control panel, using the same screws which were removed when the valve was removed.

2. Install the control handle on the Adel valve and secure with the flat-headed screw provided for that purpose. On the Bendix valve, it will be necessary to rivet the handle into place. Be sure that the control handle is positioned properly.

3. Uncap and connect the hydraulic lines leading to the control valve.

4. Bleed all air from the lines after installation.

(6) BLOWER CONTROL ACTUATING CYLINDER.

(a) DESCRIPTION.—The hydraulic cylinder that actuates the blower clutch selector valve is located on the left-hand side of the intermediate rear crankcase of each engine. (See figure 213C.) When the blower control valve is moved to the "HIGH" position, the cylinder extends, forcing the engine blower clutch selector valve up and into the "HIGH" ratio position. The "LOW" position of the blower control valve causes the cylinder to retract, thus throwing the engine blower clutch selector valve into the "LOW" ratio position. Figure 440B shows a cutaway view of the blower control cylinder. This is identical with the non-ram carburetor air filter actuating cylinder assembly shown in figure 440, with the exception of a sleeve (4, figure 440B) which limits the travel of the piston to 11/16 inch.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Relieve the hydraulic system of pressure by operating the wing flaps until the hydraulic pressure gage indicates "zero."

b. Remove the left-hand accessory cowling of the engine nacelle.

c. Disconnect and plug the two flex lines leading to the cylinder.

d. Loosen the two long, narrow Phillipps-head screws running through the indicator switch box and lay the indicator switch to one side. Do not attempt to disconnect the wiring.

e. Remove the cotter pins, castellated nuts, eyebolts, washers, and spacers that hold each end of the cylinder in place and remove the cylinder from the airplane.

2. DISASSEMBLY.—It is not recommended that the cylinder be disassembled in the field. If it becomes necessary to do so, however, refer to figure 440B and to 13.*b*.(3)*(b)* this section, preceding.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—If the two-speed blower control actuating cylinder is damaged or is not functioning properly, install a new or serviceable part.

(d) ASSEMBLY AND TESTING.—Refer to figure 440B and 13.*b*.(3)*(f)* this section, preceding. Refer also to figure 440 for the fluid leak tests of the blower control actuating cylinder before installation.

(e) INSTALLATION.—For the installation of the blower control actuating cylinder, refer to figure 213C and to the following steps:

1. Fasten the cylinder at the lower end with the bolt, spacer, washers, and castellated nut. Be sure to install the cotter pin.

2. Fasten the upper or piston rod end of the cylinder to the blower clutch selector valve arm, as shown in figure 213C, using the eyebolt, spacers, washers, and castellated nut. Do not forget the cotter pin.

3. Fasten indicator switch to bracket which is curved around actuating cylinder. Use long Phillipps-head screws, washers, and fiber insert nuts.

4. Connect the hydraulic lines to the cylinder.

(f) ADJUSTMENT AFTER INSTALLATION.—After installing the hydraulic cylinder, the unit must be adjusted to the engine selector valve and to the indicator switch for proper operation. The following steps are recommended:

1. Check stroke of piston shaft by compressing completely, placing a pencil mark on shaft at packing bushing, extending fully, and measuring distance between mark and packing bushing. This distance should be exactly 11/16 inch. (See figure 440C.)

2. Compress the shaft in the actuating cylinder completely. Remove the engine selector valve control arm and move to the serration where the holes in the arm and cylinder eye bolt align.

Note

A slight adjustment of the actuating cylinder eye bolt may be necessary for alignment. ment.

3. Install the AN 42-15 eyebolt and spacer, washers, and castellated nut.

4. Extend the actuating cylinder and check the complete operation of the engine valve with the complete stroke of the actuating cylinder.

Note

If full travel of the engine valve is not obtained within full 11/16 inch stroke of the cylinder, adjust the eyebolt on the end of the piston rod to divide the difference.

5. Extend piston rod in actuating cylinder as far as it will go, and adjust screw in plunger on indicator switch to allow 1/16 inch clearance between the AN 42-15 eye bolt and the adjusting screw. Check the red warning lights on the cockpit blower control panel to light only when piston rod is in the fully extended or "HIGH" blower position.

Note

If the 1/16 inch dimension is not maintained, the indicator lights will not function properly.

i. AUTOMATIC PILOT HYDRAULIC SYSTEM.—Hydraulic fluid for operation of the automatic pilot servo unit is supplied from the hydraulic system fluid reservoir. During normal operation the fluid pressure from the right engine-driven pump is utilized to operate the automatic pilot and the left engine-driven pump furnishes fluid pressure for the hydraulic system. The fluid delivery of the engine-driven pumps may be selected by means of the engine-driven pump selector valve. (Refer to paragraph 13.*b*.(4).) An automatic pilot emergency shut-off valve is installed on the hydraulic control panel (figure 361) to shut off flow of fluid to the automatic pilot system and return the fluid directly to the reservoir. This valve is turned to the "OFF" position only in an emergency when lines in the automatic pilot system are damaged and fluid is being lost, or for system maintenance. The valve must be left in the "ON" position during all normal operations. For complete information about the automatic pilot system refer to paragraph 11.*g*., this section.

j. HYDRAULIC TUBING AND HOSES.

(1) TUBING.

(a) DESCRIPTION. — Aluminum-alloy tubing is used for the rigid, hydraulic fluid conducting lines in this airplane. Triple-type connections, consisting of the tubing, sleeve, and BT-nut, are employed to provide a seal between tube connections. The tube is flared to join the male fitting, and the sleeve provides a bearing surface for the BT-nut. Refer to section VIII for tubing manufacturing information.

(b) REMOVAL.—All hydraulic lines in the airplane are removable as follows:

1. Relieve the hydraulic system pressure by operating the wing flaps until the hydraulic system pressure gage indicates "zero."

2. Remove access covers or plates.

3. Unscrew BT-nuts at each end of tube. Remove supporting clips and clamps. Remove tube.

4. The ends of exposed hydraulic lines must be capped immediately to prevent dust and grit from entering the hydraulic system. Do not use rubber plugs to seal exposed lines. Rubber plugs may be shredded by the threads and rubber particles may be circulated through the system.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Tubing must be inspected periodically for scratches, dents, and other deformities. Check flared ends for cracks or deformities, especially under the sleeve. Replace lines with deep scratches, dents, and other damage with new parts.

(d) INSTALLATION.—Blow out lines and fittings with clean, dry air before installation. Apply approved thread lubricant sparingly on the outside of the sleeve and on the male threads of the fitting. Spe-

cial caution must be observed when installing lines through cut-outs to prevent scarring the tubing. Mask the edges of cut-outs until after the lines are installed. Great care must be observed in tightening the BT-nuts. Overtightening may cut off completely or severely damage the tube flare. The line may blow out if the BT-nut is not tightened sufficiently. Carefully observe the wrench torque values given in section IX.

(2) FLEXIBLE HOSES. – Approved winterized flexible hose is installed on all later airplanes. Hydraulic actuating cylinders should not be handled by the flexible hoses, or allowed to hang loosely from the hoses. Flexible hose should not be bent to a radius less than nine times its outside diameter. Do not install a flexible hose so that it is subjected to a twisting load. On all flexible hose there is a stripe running the entire length of the hose to determine any twisting after installation. A hose should not be stretched tightly between two fittings. About 5 to 8 percent of the total length of the hose must be allowed for slack to prevent the hose from being pulled out of the fittings when fluid pressure is applied. Flexible hose should be protected against chafing, where necessary, by a suitable cover or boot.

k. CLIPS AND CLAMPS.

(1) DESCRIPTION.–The hydraulic lines are held in place by bonded cushion clips and clamps which are placed at definite intervals to reduce vibration of the lines. These supports provide a vibration-absorbing cushion for the lines to eliminate fatigue and mechanical damage at the attachment location of the lines. The clips and clamps are tightened sufficiently to hold the lines firmly.

(2) SERVICE.–It usually is desirable to slightly tighten the clips after several hundred hours of service to compensate for initial displacement or cold flow of the cushioning material. When this service is not done, it is possible under adverse conditions for moisture to condense or otherwise reach the bonding material with attendant corrosive action and high electrical resistance.

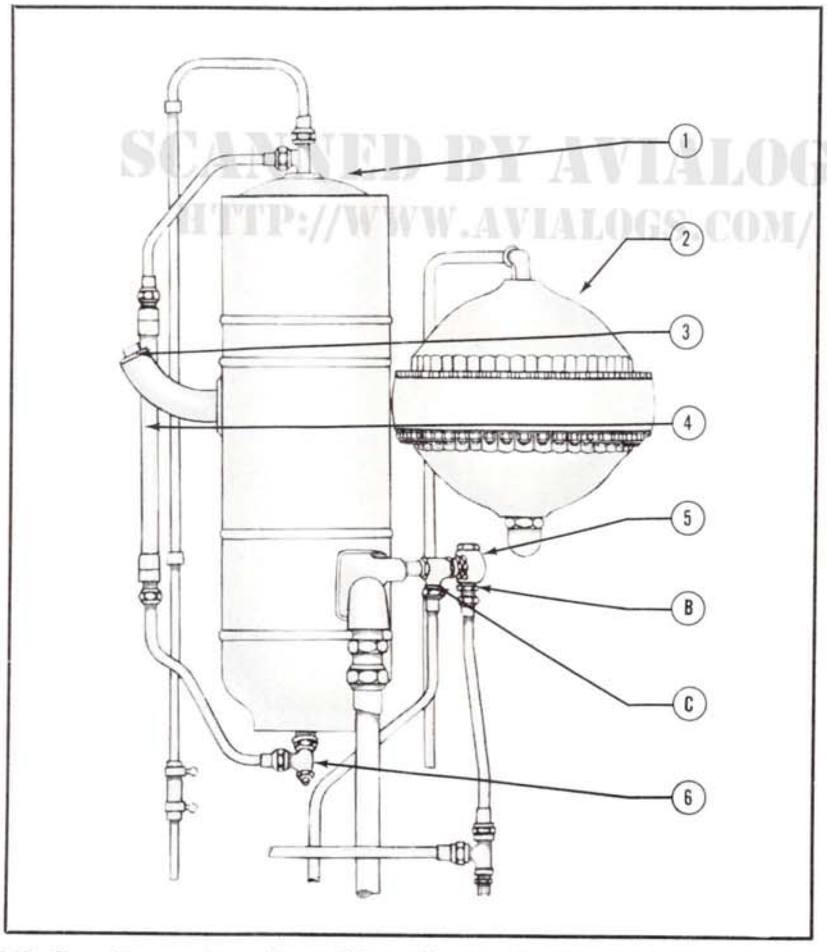


Figure 441—Test Connections—Test of Complete Hydraulic System (Looking Forward)

(Douglas Dwg. No. 5141943)

1. Hydraulic System Fluid Reservoir
2. Hydraulic System Pressure Accumulator
3. Hydraulic Reservoir Filler Neck
4. Hydraulic Reservoir Fluid Level Gage
5. Check Valve
6. Hydraulic Reservoir Drain Connection

B. Test Connection
C. Test Connection

l. Test of Complete Hydraulic System.

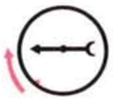
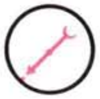
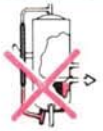
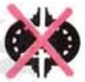
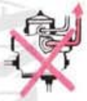
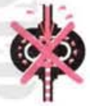
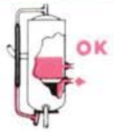
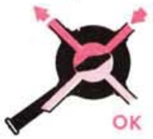
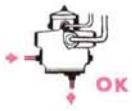
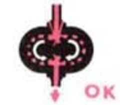
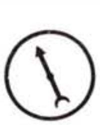
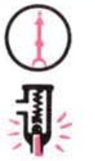
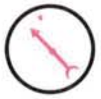
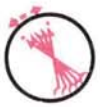
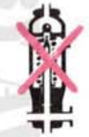
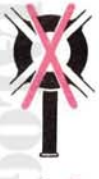
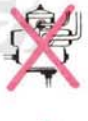
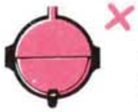
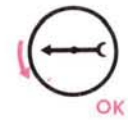
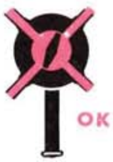
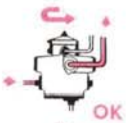
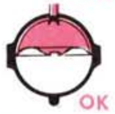
	Points of Attachment for Test Stand Lines		*Valve Positions*													
	Test Stand Pressure Line	*Test Stand Return Line*	*Lines Disconnected*	*Lines Plugged*	*Engine Selector*	*Gyro Pilot Shut-Off*	*Hand Pump To Pres. Accum. Shut-Off*	*Wing Flap*	*Landing Gear*	*Cowl Flap LH*	*Cowl Flap RH*	*Check*	*Pressure-Psi*	*Max Leakage*	*Remarks*
Test No. 1	LH pump pressure fitting on fire wall	LH pump suction fitting on fire wall	Return line from regulator	Disconnected line and port in regulator. All cowl flap fittings on fire walls	LH to hyd system	Off	On (remove lock wire)	Neutral	Neutral	Trail	Trail	LH engine pressure line	875 ± 25	None	
Test No. 2	RH pump pressure fitting on fire wall	RH pump suction fitting on fire wall	Return line from regulator	Disconnected line and port in regulator. All cowl flap fittings on fire walls	RH to hyd system	Off	On (remove lock wire)	Neutral	Neutral	Trail	Trail	RH engine pressure line	875 ± 25	None	
Test No. 3	RH pump pressure fitting on fire wall	RH pump suction fitting on fire wall	Reconnect to lines above. Disconnect lines B and C and connect them to a common manifold (See figure 441)	All cowl flap fittings on fire walls	LH to hyd system	Off	On (remove lock wire)	Neutral	Neutral	Trail	Trail	All return lines	100 ± 10	None	
Test No. 4	RH pump pressure fitting on fire wall	RH pump suction fitting on fire wall	Reconnect lines B and C	All cowl flap fittings on fire walls	RH to hyd system	Off	On (remove lock wire)	Neutral	Neutral	Trail	Trail	Regulator kick-off	875 ± 25		
Test No. 5	RH pump pressure fitting on fire wall	RH pump suction fitting on fire wall	Reconnect lines B and C	All cowl flap fittings on fire walls	RH to hyd system	Off	On (remove lock wire)	Operate to make regulator kick-in	Neutral	Trail	Trail	Regulator kick-in	600 Min		
Test No. 6	RH pump pressure fitting on fire wall	RH pump suction fitting on fire wall	Reconnect lines B and C	All cowl flap fittings on fire walls	RH to hyd system	Off	On (remove lock wire)	Neutral	Neutral	Trail	Trail	System relief valve	1000 ± 50		
Test No. 7	Tee in brake line in nose	RH pump suction fitting on fire wall	Reconnect lines B and C	All cowl flap fittings on fire walls	RH to hyd system	Off	On (remove lock wire)	Neutral	Neutral	Trail	Trail	Brake lines and connections	825 ± 25	None	Open brake valve to allow 825 psi pressure in brake lines
Test No. 8	Tee in brake line in nose	RH pump suction fitting on fire wall	Reconnect lines B and C	All cowl flap fittings on fire walls	RH to hyd system	Off	On (remove lock wire)	Up	Down	Trail	Trail	All wing flap up lines and connections All ldg gr down lines and connections	1000 ± 50	None	
Test No. 9	Tee in brake line in nose	RH pump suction fitting on fire wall	Reconnect lines B and C	All cowl flap fittings on fire walls	RH to hyd system	Off	On (remove lock wire)	Same	Up*	Trail	Trail	All ldg gr up lines and connections	1000 ± 50	None	*Mechanical latch to be locked **If necessary, maintain pressure by constant pumping
Test No. 10	Tee in brake line in nose	RH pump suction fitting on fire wall	Reconnect lines B and C	All cowl flap fittings on fire walls	RH to hyd system	Off	On (remove lock wire)	Down**	Up*	Trail	Trail	All wing flap down lines and connections	1000 ± 50	None	
Test No. 11	Both cowl flap lines in RH nacelle	RH pump suction fitting on fire wall	Reconnect lines B and C	Tee in brake line	RH to hyd system	Off	Off	Neutral	Neutral	Off	Off	All RH cowl flap lines and connections	1200 ± 50	None	
Test No. 12	Both cowl flap lines in LH nacelle	RH pump suction fitting on fire wall	Reconnect lines B and C	Tee in brake line	RH to hyd system	Off	Off	Neutral	Neutral	Off	Off	All LH cowl flap lines and connections	1200 ± 50	None	

After completion of the above tests replace the lock wire on the hand pump to pressure accumulator shut-off valve.

Check to see that the line disconnected in test No. 1 has been reconnected; that lines B and C disconnected in test No. 3 have been reconnected, and that the cap on the tee in the brake line in the nose has been replaced.

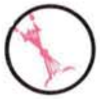
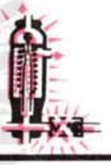
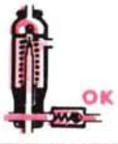
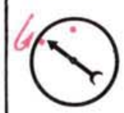
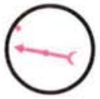
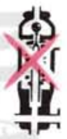
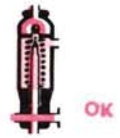
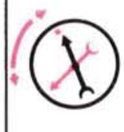
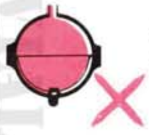
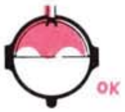
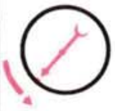
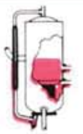
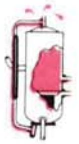
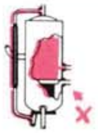
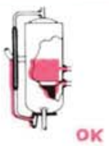
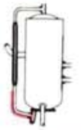
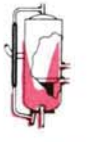
ENGINE-DRIVEN PUMPS IN OPERATION

C-47 SERIES HYDRAULIC SYSTEM TROUBLE-SHOOTING CHART

	NORMAL OPERATION	TROUBLE INDICATION	POSSIBLE CAUSE OF TROUBLE	MECHANICAL CHECK AND REMEDY
1	 System pressure gage indication rises from zero when the engines start, denoting engine-driven hydraulic pumps have begun normal pressure delivery.	 *a.* System pressure gage indication remains at zero. *b.* Slight pressure rise indication.	 *a.* (1) Loss of hydraulic fluid cuts off supply of fluid to engine-driven pumps.  (2) Inoperative engine-driven hydraulic pump.  (3) Pressure regulator locked in "unloading" position  *b.* (1) Loose hose or line connection bleeding air into pump supply line. (2) Break in line in pressure system.	 *a.* (1) Refill reservoir to proper level with hydraulic fluid.  (2) Move handle on engine selector valve to forward position. If pressure now rises normally, check *b.* (1) below. (3) Replace hydraulic regulator.  *b.* (1) Straighten twisted hoses. Tighten loose suction line or hose connections and check for air leaks. Bleed air from supply lines. (2) Check for external hydraulic leaks and repair.  (3) If trouble persists, replace left engine hydraulic pump.
2	 With no hydraulic units in operation system pressure gage indication remains at 875 psi (approximately), denoting that pressure regulator valve is relieving engine-driven hydraulic pump load, and pressure system is tight.	 *a.* System pressure gage indication rises to and remains at 1000 psi, and system relief valve chatters, relieving excess system pressure.  *b.* System pressure gage indication does not rise to 875 psi when engine pump selector valve engages either pump.  *c.* Pressure gage oscillates between 875 psi (approximately) and 650 to 725 psi (approximately).	 *a.* Pressure regulator fails to relieve load on engine-driven pumps at 875 psi.  *b.* (1) Defective engine selector valve or improper handle timing on valve allows system pressure to leak to Auto-Pilot system.  (2) Pressure regulator not adjusted properly.  *c.* (1) Improper air charge in accumulator or damaged accumulator diaphragm.	 *a.* Relieve the system operating pressure by operating the wing flaps until the system pressure gage indicates zero. Replace pressure regulator.  *b.* (1) Check handle timing. Relieve pressure and tighten plug on plug type valves. If trouble reoccurs, replace valve.  (2) Adjust pressure regulator valve to 875 psi kickout pressure.  *c.* (1) Test accumulator for damaged diaphragm and proper air charge per item 12 below. Replace diaphragm or air charge if necessary.

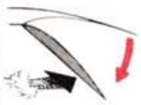
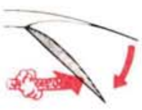
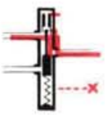
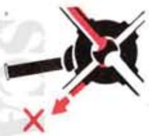
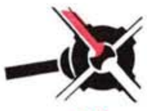
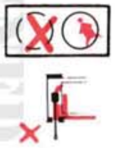
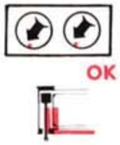
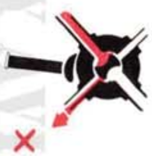
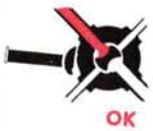
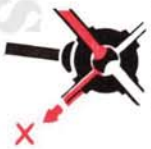
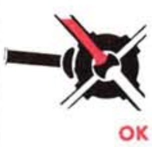
SCANNED BY AVIALOGS HTTP://WWW.AVIALOGS.COM/

ENGINE-DRIVEN PUMPS IN OPERATION

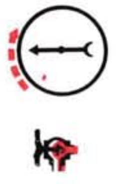
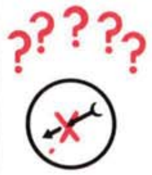
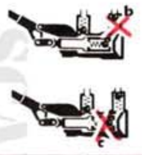
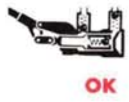
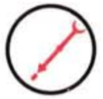
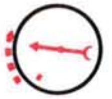
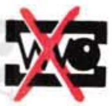
	NORMAL OPERATION	*TROUBLE INDICATION*	*POSSIBLE CAUSE OF TROUBLE*	*MECHANICAL CHECK AND REMEDY*
2	(ITEM 2 CONTINUED)		C. (2) External or internal leak in pressure system.	C. (2) Check for external leaks. Put all valves in closed or neutral position. If this stops trouble, replace packings in faulty hydraulic actuator. If trouble still exists, replace pressure regulator bypass check valve when Douglas regulator is installed or replace pressure regulator when Bendix regulator is installed.
		 d. (1) Pressure regulator chatters. d. (2) With Bendix type regulator in system, regulator chatters or pressure oscillates between 875 psi and some pressure above 750 psi.	 *d.* (1) Pressure regulator bypass check valve leaks. (2) Internal leak in Bendix type regulator.	 d. (1) Relieve system pressure and replace pressure regulator by-pass line check valve or Bendix regulator. d. (2) Replace Bendix regulator
3	 With any hydraulic unit in operation, pressure drops steadily to approximately 650 to 725 psi, then rises to approximately 875 psi at or before completion of operation of unit, indicating normal operation of pressure regulator. (Note: Pressure may fall lower during operation of landing gear or wing flaps.)	 *a.* System pressure indication falls below 650 psi before the pressure regulator reengages engine-driven pump fluid delivery.	 *a.* Pressure regulator is not operating properly and fails to reengage engine-driven pump fluid delivery at 650 psi.	 *a.* Relieve system pressure and replace pressure regulator.
		 *b.* System pressure drops rapidly very low and rises very quickly to approximately 875 psi at end of actuation period. Cylinder action is delayed.	 *b.* Improper air charge in accumulator or damaged accumulator diaphragm affords no cushion to system operation.	 *b.* Test accumulator for damaged diaphragm and proper air charge per item 12 below. Replace diaphragm or air charge as necessary.
		 *c.* System fluid pressure is utilized and system pressure gage indication falls to zero and remains there.	*c.* Same as item 1.	*c.* Same as item 1.
4	 Fluid level in reservoir sight gage indicates normal level as noted on placard.	 *a.* Fluid level in reservoir sight gage rises above normal flight level and hydraulic fluid overflows through vent line.	 *a.* Hydraulic reservoir strainer is clogged.	 *a.* Drain hydraulic reservoir. Remove reservoir, disassemble and clean strainer. Reassemble and re-install reservoir. Refill reservoir with hydraulic fluid.
		 *b.* Fluid level falls out of sight in gage glass when engine pumps are running.	 *b.* Loss of oil or normal incorrect gage reading due to whirling vortex of oil in the tank.	*b.* Check oil level with engines stopped per placard on hydraulic panel. Refill reservoir if necessary and check system for external leaks.

C-47 Series Hydraulic System Trouble-shooting Chart

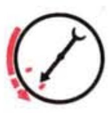
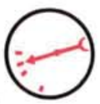
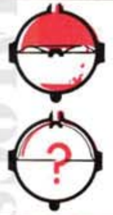
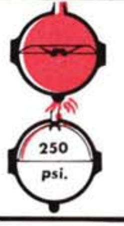
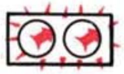
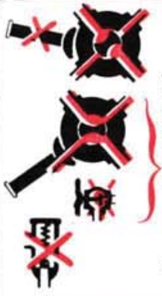
ENGINE-DRIVEN PUMPS IN OPERATION

	NORMAL OPERATION	TROUBLE INDICATION	POSSIBLE CAUSE OF TROUBLE	MECHANICAL CHECK AND REMEDY
5	 Wing flaps may be lowered ¾ down at the maximum airspeed of 112 mph, denoting proper adjustment of the wing flaps relief valve.	 Wing flaps go ¾ down at airspeeds in excess of 112 mph.	 Wing flaps relief valve adjustment has been changed by reduced packing friction in wing flap actuating cylinder or by improper adjustment of the relief valve.	OK Install pressure gage at wing flap relief valve and with full system pressure, check valve for proper relief pressure of 430 to 485 psi.
6	Wing flaps remain in "UP" position during flight, denoting proper functioning of wing flaps control valve.	Wing flaps droop during flight when wing flaps control valve handle is in the "NEUTRAL" position.	 Defective wing flaps control valve, loose plug screw, or incorrect handle timing allows fluid pressure to leak into the "DOWN" line.	 OK Relieve system pressure and tighten plug screw on plug type valves. Check handle timing on Saval type valves. If trouble reoccurs, replace wing flaps control valve.
7	Landing gear pressure gage indication is the same as the hydraulic system gage, denoting normal condition of landing gear pressure gage and that landing gear control valve handle is in the "DOWN" position.	Landing gear pressure gage indicates different pressure than hydraulic system pressure gage when landing gear operating valve handle is in the "DOWN" position.	 *a.* Damaged or defective landing gear pressure gage. *b.* Internal fluid leakage in landing gear actuating cylinder or compensating cylinder.	 OK *a.* Relieve system pressure and replace landing gear pressure gage. *b.* Relieve system pressure and replace packing in landing gear actuating cylinders or compensating cylinders.
8	Landing gear stays up during flight with landing gear control valve in neutral.	Landing gear drops during flight with landing gear control valve in neutral.	 *a.* Defective landing gear control valve, loose plug screw or incorrect handle timing causing internal leakage in valve. *b.* See item 7 *b.* above. *c.* External leakage at lines, hoses, or fittings.	 OK *a.* Relieve system pressure and tighten plug screw on plug type valves. Check handle timing on Saval type valves. If trouble reoccurs, replace landing gear valve. *b.* See item 7 *b.* above. *c.* Check for external leaks and repair.
9	LANDING GEAR Landing gear pressure gage indicates zero when landing gear control valve handle is moved from "UP" to "NEUTRAL", denoting proper functioning of landing gear control valves and proper adjustment of plug screw.	LANDING GEAR Landing gear pressure gage indicates pressure in excess of 250 psi in 20 to 30 minutes (normal thermal expansion) after landing gear control valve handle has been moved to the "UP" position and returned to the "NEUTRAL" position.	 *a.* Handle moved too slowly. *b.* Defective landing gear control valve, loose plug screw, or incorrect handle timing allows fluid pressure to leak into the "DOWN" line.	 OK *a.* Move handle rapidly when operating valve. *b.* Relieve system pressure and tighten plug screw on plug type valves. Check handle timing on Saval type valves. If trouble reoccurs, replace landing gear control valve.

HAND PUMP IN OPERATION

	NORMAL OPERATION	TROUBLE INDICATION	POSSIBLE CAUSE OF TROUBLE	MECHANICAL CHECK AND REMEDY
10	 With hand pump shut-off valve open, and all system valves in closed or neutral positions, system pressure gage indicates rise of system pressure at each stroke of hand pump, indicating sufficient fluid supply and proper functioning of hand pump check valves.	 *a.* No pressure or resistance on any stroke. *b.* No pressure rise on down stroke. *c.* No pressure rise on up stroke.	 *a.* Complete loss of hydraulic fluid, or open line in system. *b.* Defective check valve in hand pump supply port. *c.* Defective check valve in hand pump piston, or defective piston packing.	 *a.* Repair any leaking lines and fittings and refill reservoir. *b.* Relieve system pressure and replace defective check valves or packings. *c.* Relieve system pressure and replace defective check valves or packings.
11	With hand pump shut-off valve closed, system pressure gage indicates slight pressure rise when hand pump is operated.	 a. System pressure gage indicates no pressure rise.	a. Hand pump shut-off valve bleed hole is clogged.	a. Relieve system pressure and clean bleed hole in hand pump shut-off valve plug.
		 b. System pressure gage indicates full system pressure being developed by operation of hand pump.	 b. Defective system check valve between hand pump shut-off valve and pressure accumulator.	b. Relieve system pressure and replace system check valve.

NO PUMPS IN OPERATION

12	 When relieving system pressure, the system pressure gage indicates a steady pressure decrease to 250 psi, then drops suddenly to zero, denoting proper air charge in pressure accumulator.	 System pressure gage indication before sudden drop to zero is more or less than 250 psi.	 *a.* Pressure accumulator diaphragm is damaged. *b.* Pressure accumulator has improper air charge.	 *a.* Test for fluid leaks at the accumulator air valve. Replace damaged accumulator diaphragm. *b.* Relieve all hydraulic pressure and charge pressure accumulator to correct air pressure, 250 psi.
13	On the ground, landing gear and system pressure gages indicate equal fluid pressure increase caused by thermal expansion of hydraulic fluid, denoting that landing gear control valve handle is in "DOWN" position. Neither gage indication exceeds 1000 psi.	a. System pressure gage indicates pressure up to 1000 psi, maximum pressure in system because of system relief valve. Landing gear pressure gage may indicate in excess of 1000 psi and fluid pressure in excess of 2000 psi will damage the landing gear pressure gage.  b. Pressures in excess of 1000 psi are indicated on both gauges.	 a. Landing gear control valve handle is in the "NEUTRAL" position or landing gear control valve handle is in "DOWN" position and bleed hole in hand pump shut-off valve is clogged. b. System relief valve inoperative.	a. Place landing gear control valve handle in "DOWN" position. If landing gear pressure gage indicates no relieving of excess pressure, open the hand pump shut-off valve. Relieve system pressure and clean bleed holes in hand pump shut-off valve. b. Replace system relief valve.

C-47 Series Hydraulic System Trouble-shooting Chart

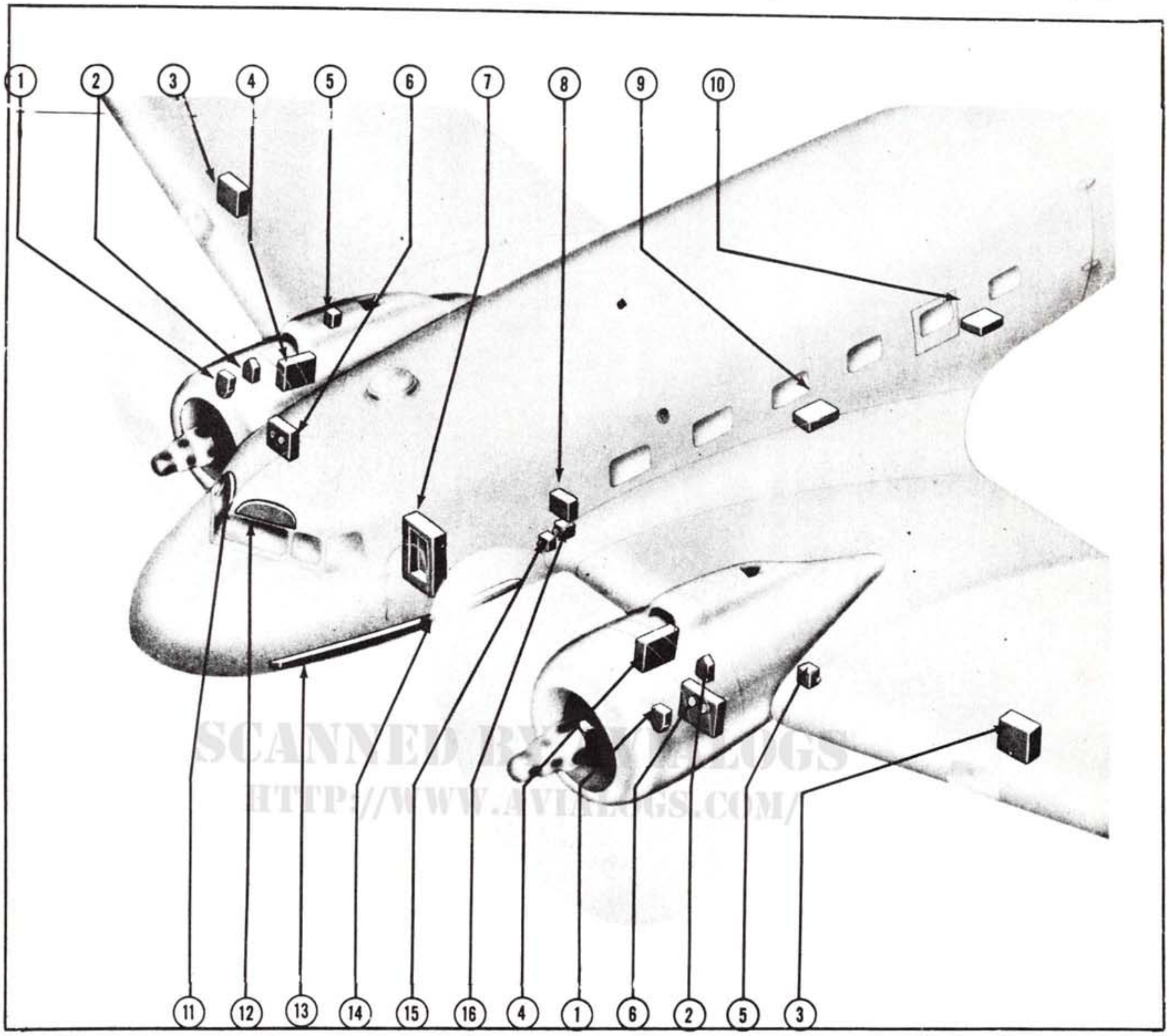


Figure 442—Control Panels and Junction Boxes

1. Engine Section Pull Box
2. Ignition Plug Junction Box
3. Outer Wing Junction Box (C-47 Only)
4. Inboard Nacelle Junction Box
5. Outboard Nacelle Junction Box
6. Fire Wall Junction Box
7. Main Electrical Junction Box
8. Center Wing Junction Box
9. Center Parapack Junction Box
10. Aft Parapack Junction Box
11. Right-hand Electrical Control Panel
12. Left-hand Electrical Control Panel
13. Left-hand Electrical Tunnel
14. Tunnel Junction Box (C-47 Only)
15. Center Wing Ignition Junction Box
16. Center Wing Generator Junction Box

14. ELECTRICAL SYSTEM.

Note

> This paragraph includes the 12-volt C-47 electrical system and the 24-volt C-47A electrical system. The 12-volt C-47 system begins with paragraph 14.*a.;* the 24-volt C-47A system begins with paragraph 14.*b.* following.

a. GENERAL—C-47.—The electrical system on the C-47 airplanes is a 12-volt direct current, single-wire, ground return system.

(1) ELECTRICAL PANELS. *(See figure 443.)*

(a) DESCRIPTION.

1. LEFT-HAND ELECTRICAL PANEL.—The left-hand electrical panel (2, figure 443) is mounted forward of the pilot's seat, above the left windshield. The panel contains the following units: the compass lamps rheostat, the panel lamps rheostat, the left propeller feathering switch, the two battery master switches, the two landing lamp switches, the running (position) lamps switch, the passing lamp switch, the propeller de-icer switch, the pitot heater switch, the

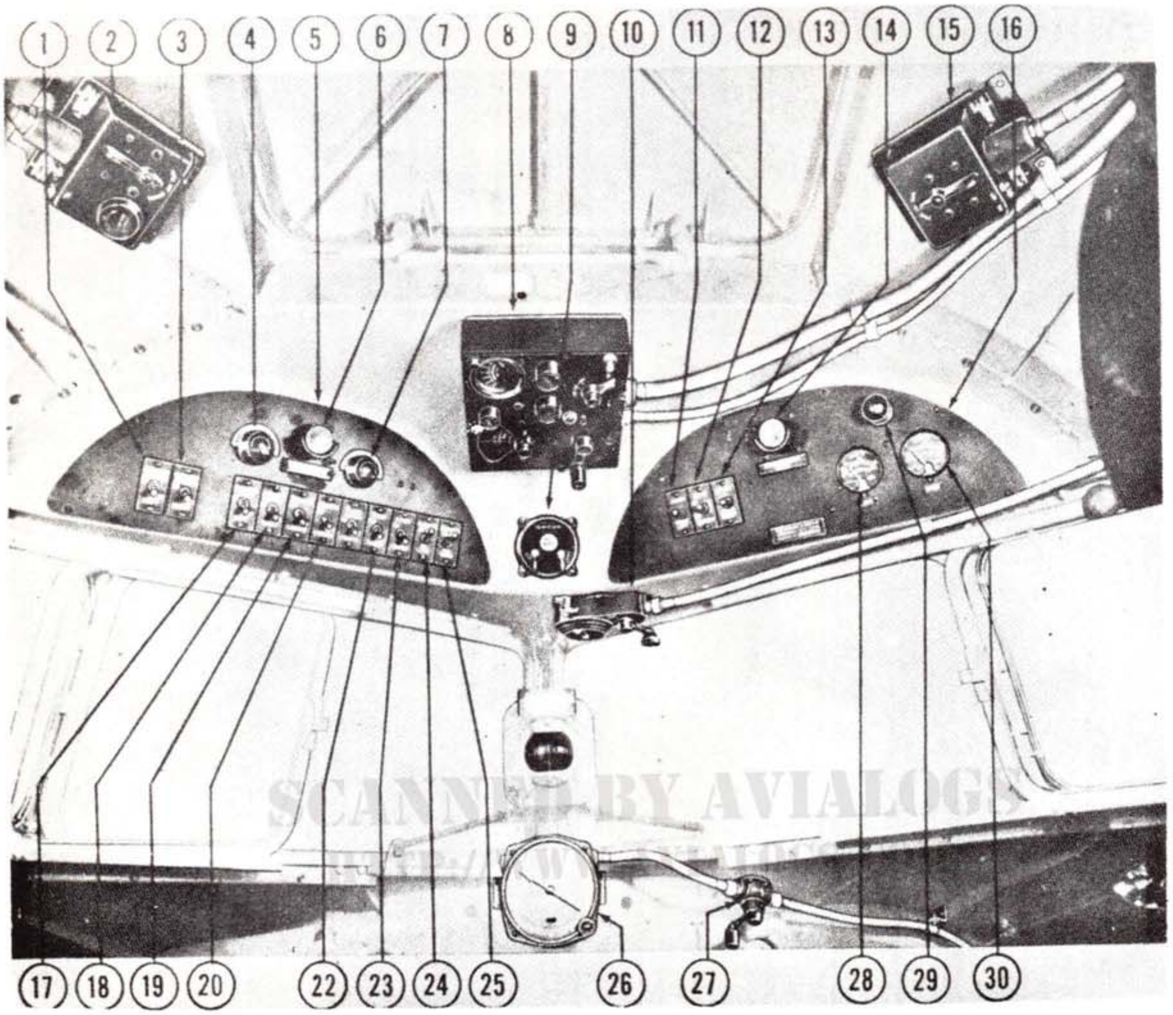


Figure 443—Electrical Panels, Pilots' Compartment (C-47-R4D-1)

1. Left Battery Master Switch
2. SCR-( )-183 Command Receiver Control Box
3. Right Battery Master Switch
4. Compass Light Switch
5. Electrical Control Panel, Left
6. Left Propeller Feathering Switch
7. Panel Lights Switch, Left
8. SCR-280-A Radio Compass Control Box
9. Ignition Switch
10. SCR-( )-183 Command Receiver Remote Tuning Unit
11. Left Starter Switch
12. Starter Safety Switch
13. Right Starter Switch
14. Right Propeller Feathering Switch
15. SCR-( )-183 Command Transmitter Control Box
16. Electrical Control Panel, Right
17. Left Landing Light Switch
18. Right Landing Light Switch
19. Running Lights Switch
20. Cockpit Lights Switch
21. (Deleted)
22. Propeller De-Icer Switch
23. Pitot Heater Switch
24. Left Engine Oil Dilution Switch
25. Right Engine Oil Dilution Switch
26. SCR-280-A Radio Compass Bearing Indicator
27. SCR-280-A Radio Compass Bearing Indicator Control Unit
28. Left Ammeter
29. Panel Light
30. Right Ammeter

two oil dilution switches, and two tuning control and compass lamps resistors (on back of panel). On most airplanes, there are also the following: the guarded bail-out (alarm bell) switch, guarded parapack salvo switch, fluorescent lamps switch, cockpit lamps switch, paratroop warning lamps switch. On some airplanes, there are two pitot heater switches, the oil dilution switches have a position at which the engine primers are operated, and there are two position lamp switches (wing and tail).

2. RIGHT-HAND ELECTRICAL PANEL.—The right electrical panel (16, figure 443) contains: two ammeters, right propeller feathering switch, two starter switches, starter safety switch, ammeter lamp, and recognition lamp switches. On some airplanes, there are also the following switches:

the carburetor anti-icer switch, the fluorescent lamps switch, and the cockpit lamps switch. On most airplanes, a resistor for the tail cone position lamp is mounted on the back of the panel. On some airplanes, two voltammeters are provided, instead of the two ammeters.

(b) REMOVAL.

1. Remove screws attaching panel to fuselage.

2. Pull panel forward far enough to disconnect the terminals at the switches, rheostats, and resistors.

3. Remove panel and remove switches, rheostats, and resistors.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(2) JUNCTION BOXES. *(See figure 442.)*

(a) DESCRIPTION.

1. MAIN ELECTRICAL JUNCTION BOX.—The main electrical junction box (figure 444) is installed on the forward side of the forward bulkhead of the navigator's compartment (left-hand baggage compartment, on some airplanes). The top part of the box cover is a spring-hinged door which opens forward. A lamp in the top of the box is turned "ON" when the door is open, by the operation of a switch inside the box. Inside the small door are the two main line generator switches. The whole junction box cover may be removed by removing the spring screws around the edge of the cover. Inside the junction box are the following units: the two generator control panels, the two battery connector relays, the two condensers, the two voltammeter shunts, the antenna reel control box lamp relay, connector panels, and the fuse panel. The fuse panel contains fuses for the various protected circuits of the airplane's electrical system. Every fuse is supplied with a spare. To provide adequate cooling provisions, a half-section venturi, secured to the left side of the fuselage at approximately station 136–1/2, is connected to the junction box with flexible tubing.

2. FIRE WALL JUNCTION BOXES.—One fire wall junction box (figure 469) is mounted on the forward side of each fire wall. Each junction box contains a starter relay, a propeller feathering relay, landing lamp circuit fuse, connecting bus bars, and connector panels. One ignition plug junction box is mounted on the forward side of each fire wall for the connection of the generator and magnetos with the fire wall.

3. NACELLE JUNCTION BOXES.—Two junction boxes, one on the inboard wall and one on the outboard wall, are mounted in each nacelle. The outboard nacelle junction box contains a connector panel. The inboard nacelle junction box contains the landing lamp relay and a connector panel.

4. ENGINE SECTION PULL BOX.—One pull box is mounted in each engine section and is provided for the interconnection of the various electrical units of the engine.

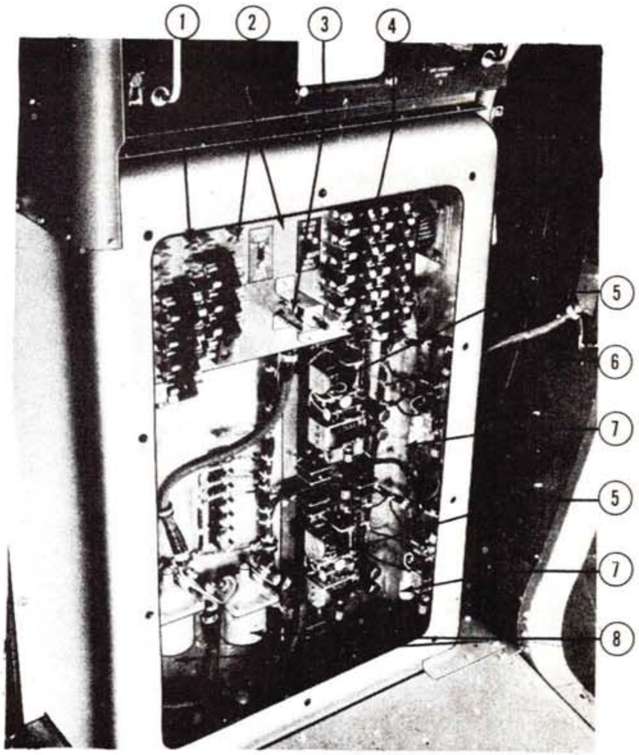


Figure 444—Main Electrical Junction Box (C-47)

1. Spare Fuses
2. Main Line Generator Switches
3. Junction Box Lamps Switch
4. Fuse Panel
5. Generator Control Panel
6. Forward Door Warning Lamp Limit Switch
7. Generator Condenser
8. Battery Connector Relay

5. CENTER WING JUNCTION BOXES.—One center wing junction box, one ignition plug junction box, and one generator plug junction box is installed in the forward part of the center wing section. These boxes contain connector panels only and are used for the connection of the fuselage and wing wiring. The boxes can be reached by removing the fillet on the under side of the center wing, next to the left-hand wing leading edge.

6. OUTER WING JUNCTION BOXES.—One junction box is mounted in each outer wing section, aft of each landing lamp. The box contains a terminal panel used for the connection of the center and outer wing wiring. The box can be reached through the landing lamp access panel, on the top of the wing.

7. FUSELAGE TUNNEL GENERATOR JUNCTION BOX.—One junction box is installed in the fuselage electrical wiring tunnel (lower left-hand side of fuselage) and contains a terminal panel connecting the generator wires from the center wing section to the fuselage.

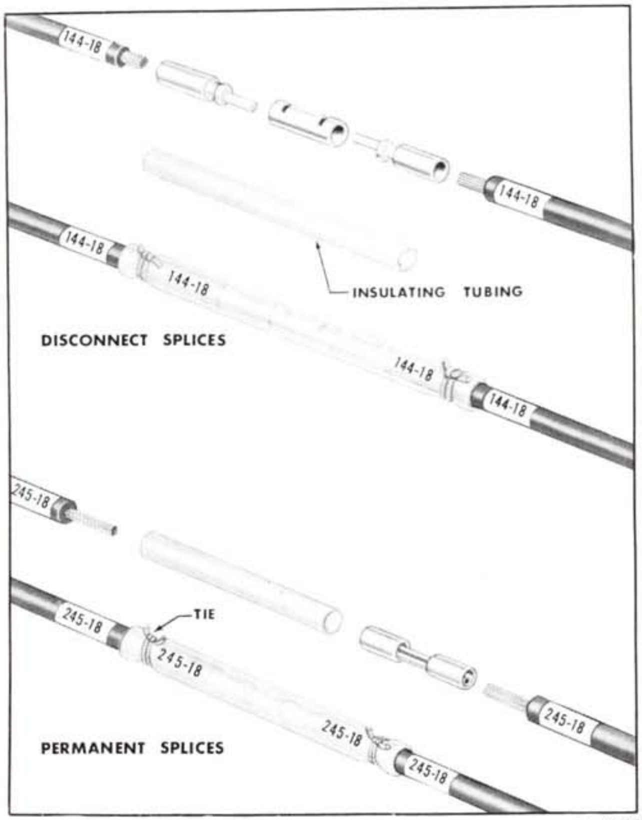


Figure 445–Splices

8. PARAPACK JUNCTION BOXES.–One parapack junction box (figure 470), mounted in the aft section of the center wing section, contains the parapack salvo relay, four parapack release relays (for the four forward parapacks), and connector panels. One parapack junction box (figure 471), mounted in the lower section of the center fuselage, forward of the recognition lamps, contains two parapack release relays (for the two aft parapacks) and connector panels. The parapack junction boxes can be reached by taking up the floor in the main cargo compartment.

(b) REMOVAL.–The junction boxes may be removed by disconnecting all connecting wires and removing screws attaching box to mount.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary.

(3) WIRING.

(a) DESCRIPTION.–The wiring system on this airplane is centralized for connection to power at the fuse bus in the main junction box and at the two nacelle buses. Power is supplied to the airplane electrical system through fuses connected to the fuse bus in the main electrical junction box or through relays connected to the buses in the fire wall junction boxes. All wiring from the fuselage to either wing is connected through terminal strips in the left-hand tunnel. All the wiring on some airplanes is carried in conduit; other airplanes are provided with conduit for the wiring from the engine section only. The wiring for the individual circuits of the airplane electrical system is shown in the wiring diagrams at the end of this paragraph. These wiring diagrams must be referred to for the removal or replacement of any electrical units.

(b) IDENTIFICATION OF WIRE.

1. Each wire bears an identification number at 1-inch intervals along the first 6 inches at each end and at intervals not greater than 15 inches along the remainder of its length.

2. Wires 15 inches or less in length bear identification numbers at 1-inch intervals only.

3. The wire identification number consists of the wire numbers followed by the gage size of the wire.

4. An arrow is used to indicate the direction in which the number is to be read.

5. On unshielded wires Nos. 20 to 4, the identification consists of the number stamped on the outer covering of the wire; unshielded wires larger than No. 4 carry numbers covered with transparent tape.

6. On shielded wire, the identification consists of ¾-inch lengths of insulating tubing, or transparent cellulose tape, bearing the identification number placed over the wire at 15-inch intervals.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. SPLICING. *(See figure 445.)*

a. Splicing is made in standard types of flexible stranded copper wire, sizes 10 to 22 inclusive. (Refer to the accompanying splicing table.)

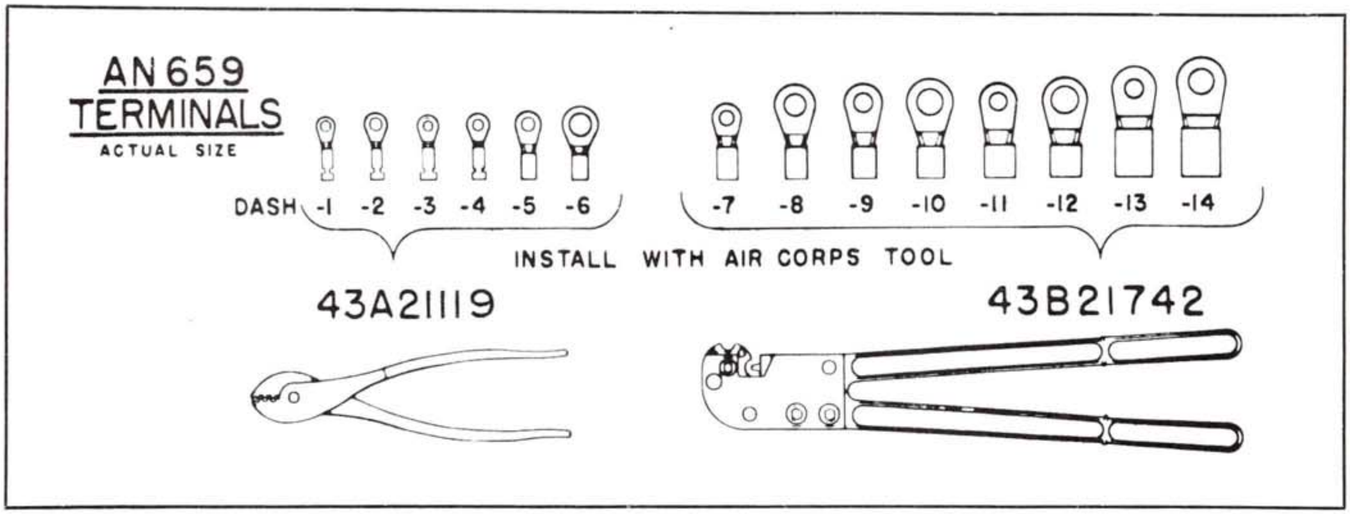

AN 659
TERMINALS
ACTUAL SIZE
DASH -1 -2 -3 -4 -5 -6
-7 -8 -9 -10 -11 -12 -13 -14
INSTALL WITH AIR CORPS TOOL
43A21119
43B21742

Figure 446—AN 659 Terminals (Actual Size)

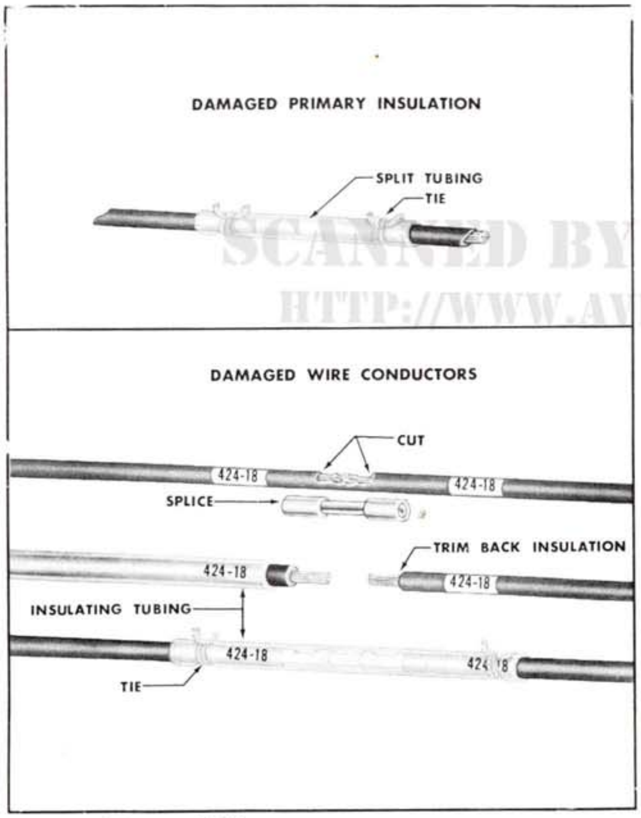

DAMAGED PRIMARY INSULATION
SPLIT TUBING
TIE
DAMAGED WIRE CONDUCTORS
CUT
424-18
424-18
SPLICE
TRIM BACK INSULATION
424-18
424-18
INSULATING TUBING
424-18
424-18
TIE

Figure 447—Wire Repair

SPLICES

Wire Gage	Thomas & Betts		Aircraft Marine Products	Burndy	Surco ID	Insulating Tubing		
	Permanent	Disconnect				American Wall	ID	Irvolite Wall
22	AA	A57	30956	YSV18	.133	.018	.133	.016
20	AA	A57			.138	.018	.148	.016
18	AA	A57			.148	.018	.148	.016
16	BB	B57	30954	YSV14	.177	.018	.186	.020
14	BB	B57			.196	.020	.208	.020
12	CC	C58	30934	YSV10	.234	.020	.234	.020
10	CC	C58			.234	.020	.234	.020

b. Splices, when made in bundles, should be staggered.

c. Splices should be used in accessible wiring tunnels or in open wiring.

d. Splices should be installed in such a manner as to allow the splice wires to follow the same routing as would have been used for unspliced wires.

2. WIRE REPAIR. *(See figure 447.)*

a. If necessary to replace terminals, select proper terminal for wire size, from the accompanying list, and as shown in figure 446. The use of solderless terminals (AN 659) is authorized when using tools (43A21119 and 43B21742).

ELECTRICAL SOLDERLESS TERMINALS
ARMY-NAVY STANDARD AN 659

Wire Size	*Screw Size*	*Terminal No.*
22, 20, 18	No. 4 or No. 6	AN 659-1
22, 20, 18	No. 8 or No. 10	AN 659-2
16, 14	No. 4 or No. 6	AN 659-3
16, 14	No. 8 or No. 10	AN 659-4
12, 10	No. 8 or No. 10	AN 659-5
12, 10	¼ in. or 5/16 in.	AN 659-6
8	No. 8 or No. 10	AN 659-7
8	5/16 in.	AN 659-8
6	¼ in.	AN 659-9
6	⅜ in.	AN 659-10
4	¼ in.	AN 659-11
4	⅜ in.	AN 659-12
2	¼ in.	AN 659-13
2	⅜ in.	AN 659-14

b. Select the proper connector and tubing for a damaged wire from the accompanying splicing table.

c. Trim the insulation back on wire for a distance equal to the shank length of the connector being used.

d. Slip the tubing over the wire.

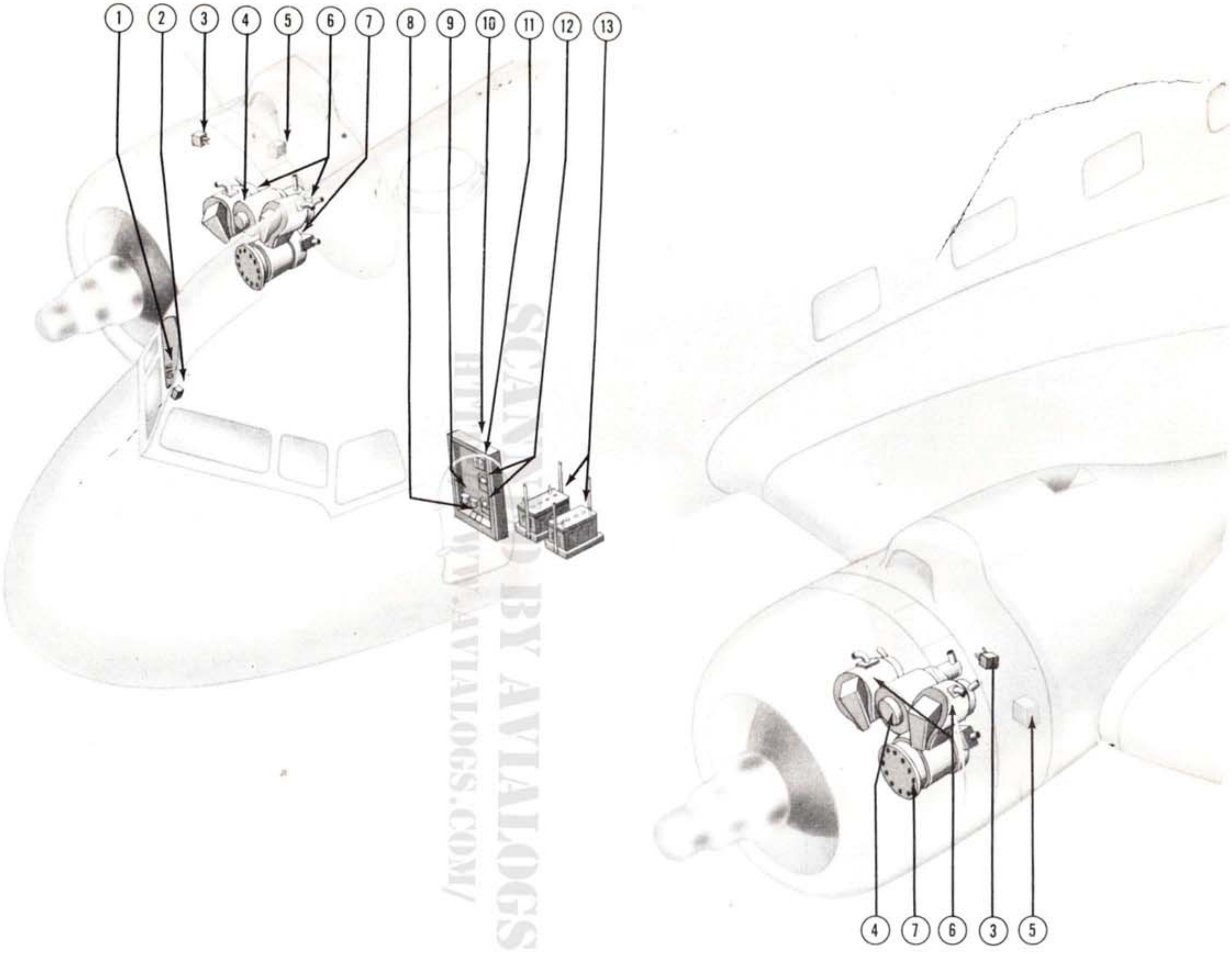


Figure 448—Power System

1. Starter Switches
2. Ignition Switch
3. Induction Vibrator (or Booster Coil)
4. Starter
5. Reverse-Current Relay (C-47A Only)
6. Magneto
7. Generator
8. Voltage Regulators (C-47A Only)
9. Battery Connector Relay (Two Relays on C-47 Only)
10. Main Electrical Junction Box
11. Main Line Generator Switches
12. Generator Control Panels (C-47 Only)
13. Batteries

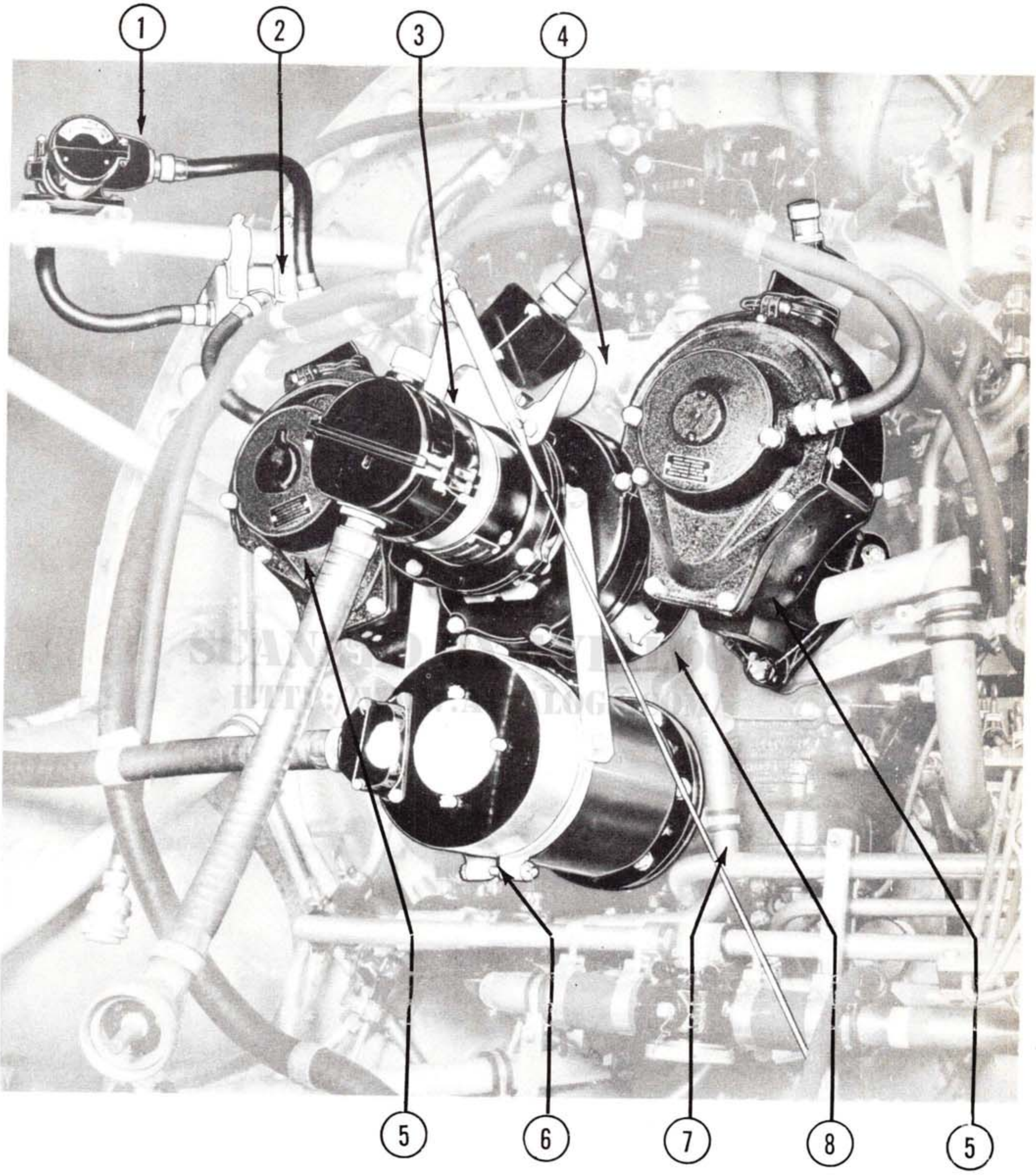


Figure 449—Power Plant Electrical System (C-47)

1. Booster Coil	5. Magneto
2. Engine Section Pull Box	6. Generator
3. Engine Starter	7. Starter Manual Meshing Cable
4. Starter Meshing Solenoid	8. Starter Hand Crank Extension Receptacle

e. Attach the connector to the bare end of the wire.

f. Slide the tubing over the terminal extending equally beyond the splice and marking tape.

g. Using a piece of No. 7 or No. 9 cord, tie a knot around each end of the tubing covering the splice.

h. Thermocouple leads must never be shortened although they may appear to be too long; these wires have been calibrated to a definite length. The removal of any portion would cause inaccuracies in the instrument reading.

Note

> If thermocouple wires are damaged, they may be tin solder-spliced if the break is in an area which is not subject to severe changes in temperature. In areas subject to severe temperature changes, such as the engine section, the splices should be silver soldered.

i. Due to the high voltage carried in the high-tension wires, they cannot be repaired but must be replaced.

(4) STATIC GROUND. — On most airplanes, ground-conducting tires are installed to remove any accumulation of static electricity and to return the airplane to ground potential. If nonconducting tires are used, a chain must be attached to the tail wheel axle which will make contact with the ground when the airplane is on the ground.

b. POWER PLANT ELECTRICAL SYSTEM. *(See figure 499.)*

(1) GENERAL. — Electrical circuits closely associated with the power plant section of the airplane are discussed in this paragraph. The ignition system, which except for the booster coil circuits is a separate system, is discussed in paragraph 6., power plant group, this section. Included in this paragraph are the generator system, the battery system, the oil dilution system, the engine primer system, and the propeller feathering system. The engine starter system is discussed in paragraph 8., this section.

(2) GENERATOR SYSTEM. *(See figure 448.)*

(a) GENERAL. — The generator system is the source of power for operating the electrical equipment on the airplane and for charging the two 12-volt storage batteries. The two generators are connected in parallel and are directly driven by the airplane engines. Each generator circuit includes a generator control panel, incorporating a voltage regulator to maintain a constant-voltage output of generators and a reverse-current cut-out relay to prevent the battery current from flowing to the generator when the engine is idling or engine is stopped. On most airplanes the two voltage regulators are connected in order to equalize the load of the two generators. A generator resistor is incorporated in the system to achieve the voltage drop necessary for the equalizing operation. Early C-47 airplanes do not incorporate this feature. A condenser is included to eliminate interference to the radios. Two voltammeters (or two ammeters) are installed in the pilots' compartment to measure the current and voltage in the circuit. The connection of the generator system to the fuse bus (and to the battery system) is made by closing the two main line generator switches located in the main junction box. For the wiring diagram of the generator system, refer to figure 472 (sheet 1).

(b) GENERATORS. *(6, figure 449)*

1. DESCRIPTION. — The two type E-7 or E-7A, 50-ampere, 15-volt generators are bolted to the generator drive pads on the accessory case of each engine. When used with the voltage regulators, the generators will operate at required capacity for an engine speed range of from 2500 to 4500 rpm. Direction of rotation is left-hand (counterclockwise), facing the shaft extension. The generator is of compound wound design and is connected in parallel with the generator of the other engine. A fan and fan vent holes are provided at the drive end of the generator to prevent overheating at full load. A spring drive coupling is provided between the engine driving member and the generator armature to reduce rotational shocks on both the engine and the generator.

2. REMOVAL.

a. Disconnect the generator cables from the terminal housing.

b. Remove the mounting bolts securing the generator to the engine.

c. Remove the generator by sliding it aft until the splined generator shaft is clear of the engine drive fitting.

CAUTION

> Support the generator when removing it; do not allow the weight of the generator to bear on the drive shaft and bend it.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. FLASHING THE GENERATOR FIELD TO CORRECT REVERSED MAGNETISM. — If the generator fails to build up voltage because of loss of residual magnetism, reversed polarity, or excessively filmed commutator, the field may be flashed as follows:

(1) Turn generator switch to "OFF" position and the battery switch to "ON".

(2) Locate position of the nearest convenient terminal or bus in the airplane for a source of battery electrical power. This may be located with a voltmeter.

(3) Remove voltage regulator from generator circuit which will be flashed.

(4) Connect one end of a suitable length of 18-gage or larger cable to the generator "A" lead terminal at the voltage regulator base.

(5) With the engine operating at normal cruising RPM, approximately 1,800, touch the other end of the cable to the power supply for approximately one second and note if a voltage is shown by the airplane generator system voltmeter or other voltmeter properly connected.

(6) If a voltage is not obtained, the generator is faulty and should be replaced. If voltage is obtained, reinstall voltage regulator and turn on generator switch and see if voltage is maintained. If voltage is not maintained, replace voltage regulator. If generator repeatedly fails to put out voltage on run-up, check generator to see if commutator is dirty or excessively coated with insulating film. Clean commutator sufficiently to

obtain continued operation. The commutator need not be cleaned to a bright surface. A slight lubrication film identifiable as a bronze discoloration is desirable for high generator load and high altitude operation. Removal and replacement of the generator may finally be necessary to obtain satisfactory service.

WARNING

> Do not flash generator field by closing reverse current relay contacts. Serious damage to the relay, the electrical system, and to the individual closing the contacts may result from the heavy current drawn from the batteries.

b. REPLACEMENT OF BRUSHES.—Generator brushes must be replaced when worn to within 1/8 inch from the brush holder or when the brush spring lever is no longer resting against the top of the brush. Minimum allowable length of a generator brush is 1/2 inch from a new length of 3/4 inch.

(1) The brush may be removed by lifting brush spring lever from the brush, and removing brush terminal attached to brush holder by a screw.

(2) Insert a new brush in the holder and seat as described in the following paragraphs.

c. SEATING THE BRUSHES.—If the generators build up insufficient voltage, or no voltage at all, because the brushes are not seated properly, seat the brushes as follows:

(1) Remove the cover band over the brush rigging.

(2) Wrap a strip of No. 000 sandpaper around commutator, sanded side out. Make sure that sandpaper conforms to contour of the commutator and that brushes press firmly on the sandpaper. Pull the sandpaper in the direction of armature rotation.

(3) Blow out dust with compressed air.

d. SMOOTHING THE COMMUTATOR.

(1) If commutator is rough, slightly burned, or glazed, smooth it by holding a piece of No. 000 sandpaper against it while generator is operated.

(2) Move the sandpaper back and forth along the length of the commutator to avoid excessive sanding in any one place.

(3) Blow all dust from the generator with dry compressed air.

Note

> If the commutator is very rough, it will be necessary to remove the generator and turn the commutator down. (Repair depots only.)

e. LUBRICATION.—No lubrication of the generator is required between overhaul periods. If oil is noted in the generator, the latter must be removed and the engine oil seal checked for leakage.

4. ASSEMBLY AND INSTALLATION.—Reverse procedure as described in paragraph 2., removal, preceding. To forestall the possibility of the generator cables becoming disconnected from either the generator or the fire wall due to engine vibration, safety the connector nuts with friction tape as follows:

a. Wrap approximately four turns of friction tape on the connector nut clockwise, and then continue the wrapping of the tape in the same direction onto the body of the connector and then onto the cable, making four or five turns on the cable.

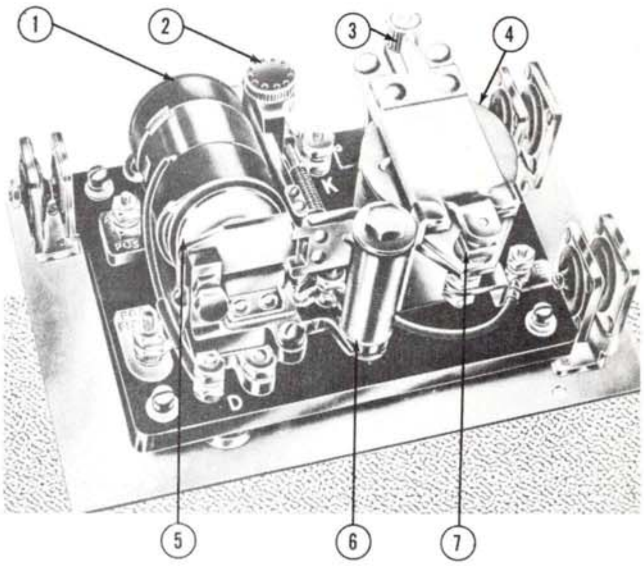


Figure 450—Generator Control Panel (C-47)

1. Voltage Regulator Element
2. Voltage Regulator Adjusting Screw
3. Reverse-Current Relay Adjusting Nut
4. Reverse-Current Relay Element
5. Voltage Regulator Contacts
6. Resistor
7. Reverse-Current Relay Contacts

b. To prevent tape from unraveling and becoming oil soaked, secure by tying a single turn of lacing cord over the tape on the cable, and shellac.

5. OPERATIONAL CHECK.

a. Start engine, using external power, if available.

b. Be sure external power plug is disconnected, otherwise generator system cannot be properly checked.

c. With both engines idling, battery switch "ON," both generator switches "ON," turn on some electrical load, such as lights, instruments, radio, etc.

d. Check generator "cut-in" by slowly increasing the engine rpm. Read the engine voltmeter. Its reading should increase to a value at which it indicates closing of the reverse current cut-out, by a dip in voltage. This should occur at approximately 13.5 volts.

e. As the engine rpm is further increased the voltage should increase to about 14.25 volts and remain there, independent of any further increase in rpm.

f. Decrease the engine rpm to idling.

g. Run both engines up to 1800 rpm. The generators should share the electrical load within 15 percent, as indicated by the ammeters.

(c) GENERATOR CONTROL PANELS.

(See figure 450.)

1. DESCRIPTION. — Two AAF type A-1A generator control panels, one for each generator, are shock-mounted in the main electrical junction box.

Each control panel includes a voltage regulator, a reverse-current relay, and a resistor. The voltage regulator controls the generator voltage by cutting the resistor in and out of the generator field circuit. The reverse-current relay automatically connects the generator to the bus when the generator voltage rises to 13.5 ± .25 volts. The relay automatically disconnects the generator from the bus when the generator voltage falls below that of the bus, thus preventing the battery from supplying current to the generator. The parallel winding of the voltage regulators are connected and are designed so that equal voltage is maintained at the output terminals of the control panel. With this condition existing, the total load connected to the two generators operating in parallel will be divided equally. A resistor is placed in each generator circuit to achieve the voltage drop necessary to the paralleling action of the voltage regulators.

2. REMOVAL.

a. Disconnect all terminals.

b. Remove the screws attaching the control panel to the side of the junction box and remove the panel.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Internal disassembly and repair will be accomplished at service depots.

b. If the contacts are dirty, remove the dirt by inserting a piece of clean paper between the contacts, pressing the contacts together, and pulling out the paper. Be sure not to leave paper lint between the contacts as this will reduce the voltage. Snapping the contacts, by opening and then letting the spring snap them shut, may help to remove the lint.

c. No lubrication is required for service activities.

d. If repairs or replacements have been made, make certain that the control unit is checked and adjusted as described in paragraph *4.*, adjustments, following.

4. ADJUSTMENTS.—Any adjustments of the generator control panel must be made by qualified personnel only.

a. ADJUSTMENT OF VOLTAGE REGULATORS FOR PROPER VOLTAGE.

(1) With both generator main line switches "OFF," start both engines and warm them up, as described in T.O. No. 01-40NC-1.

(2) Using a portable voltmeter (with a range of 30 volts and an accuracy of at least ½ of 1 percent over the full working range), ground the negative terminal of the voltmeter to the adjacent structure of the airplane and connect the positive terminal of the voltmeter to terminal "A+" on the generator control panel. The voltage regulator should warm approximately 15 minutes.

(3) Increase the speed of the engine, whose voltage regulator is being tested, to 1800 rpm; allow the other engine to idle.

(4) The voltmeter should give a reading of 14.25 volts. If it does not, adjust the voltage regulator by means of the adjustment knob (2, figure 450) next to terminal "K." Turn the knob to the right (toward terminal "K") to increase the voltage and to the left (away from terminal "K") to decrease the voltage.

(5) Reduce the engine speed to idling, and repeat the operation for the other voltage regulator. Adjust both voltage regulators to 14.25 volts.

b. ADJUSTMENT OF VOLTAGE REGULATORS FOR PARALLELING.

(1) With the engines running and the voltage regulators hot, place the two generator main line switches in the "ON" position.

(2) Turn on enough electrical equipment to total approximately 50 amperes on the ammeters.

(3) Increase the speed of both engines to 1800 rpm and note the ammeter reading for each generator. If no more than 10 amperes difference is noted in the ammeter readings, no further regulator adjustment will be made.

(4) If the generators are out of parallel by more than 10 amperes, turn the adjusting knob of the voltage regulator corresponding to the ammeter with the highest reading *one notch* in a counterclockwise direction to decrease generator output. Recheck the ammeters. If the same ammeter is still higher than the other, turn the adjusting knob of the same voltage regulator one more notch counterclockwise.

Note

Decreasing the output of one generator will increase the output of the other generator. By adjusting one voltage regulator, it is possible to bring the two generators into correspondence.

(5) Take a voltmeter reading at any convenient point in the main distribution system. The bus bar in the main electrical junction box may be used. This reading must be between 14 and 14.5 volts.

(6) If the system voltage is not between 14 and 14.5 volts, turn adjusting knobs of both voltage regulators one notch in direction to correct system voltage (counterclockwise to decrease, clockwise to increase).

c. ADJUSTMENT OF REVERSE-CURRENT CUT-OUT RELAY.—Any adjustments of this unit must be made by qualified personnel only.

(1) Connect the positive terminal of a portable precision voltmeter to the "A+" terminal of the generator control panel and ground the negative terminal to the airplane structure.

(2) Turn on the generator main line

switch and gradually increase the speed of the engine, driving the generator which produces the voltage for the relay being checked.

(3) Read the voltage at which the relay closes. This voltage should be 13.5 ± .25 volts.

Note

> There will be a voltage drop just after the contact closes. The highest voltage observed before the contacts close is to be considered the closing voltage. If the closing voltage is not 13.5 ± .25, adjust the voltage by turning the knob (3, figure 450) clockwise to raise or counterclockwise to lower the cut-in voltage.

(4) Gradually lower the speed of the generator and read the reverse current when the relay contact opens. This should be from –5 to –10 amperes.

(5) Repeat procedure for reverse-current relay on the other generator control panel.

5. INSTALLATION.—Reverse procedure as described in paragraph *2.,* removal, preceding.

(d) GENERATOR RESISTOR. *(See figure 469.)*

1. DESCRIPTION.—An Avia type 1050 generator resistor is installed on the aft side of each fire wall, above the fire wall junction box. The generator paralleling action of the two voltage regulators is dependent upon a voltage drop in the generator circuit between ground and the negative terminal of each generator. The general resistors are included to achieve this voltage drop.

2. REMOVAL.

a. Disconnect all leads.

b. Remove the screws holding the resistor to the fire wall and remove the resistor.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

4. INSTALLATION.—Reverse procedure as described in paragraph *2.,* removal, preceding.

(e) CAPACITOR.

1. DESCRIPTION.—Two type B-1, 5-mfd capacitors, AAF 50131, are installed in the main electrical junction box. A capacitor is connected in each generator circuit. The addition of the capacitor to the power system dampens interference to the radios.

2. REMOVAL. – Disconnect leads, remove screws holding capacitor to side of junction box, and remove capacitor.

3. MAINTENANCE REPAIR AND REPLACEMENT.—Replacement rather than repair, will be necessary except for tightening loose connections.

4. INSTALLATION.—Reverse procedure as described in paragraph *2.,* removal, preceding.

(f) GENERATOR MAIN LINE SWITCHES.

1. DESCRIPTION. – Two type B-13 generator main line switches C.H. 8269, one for each generator, are installed in the main electrical junction box (2, figure 444). The main line switch connects the generator circuit and the battery circuit through the fuse bus in the main electrical junction box.

2. REMOVAL.—Remove the screws holding the switch to the junction box, disconnect the wires at the back of the switch, and remove the switch.

3. MAINTENANCE REPAIR AND REPLACEMENT.—Replacement, rather than repair, will be necessary except for tightening loose connections.

4. INSTALLATION.—Reverse procedure as described in paragraph *2.,* removal, preceding.

(g) VOLTAMMETERS OR AMMETERS.

1. DESCRIPTION.—On most airplanes, two Weston 506 type S-31661 voltammeters, one for each power plant system, are installed in the right-hand electrical panel (5, figure 443). The instrument is normally wired through the shunt of the shunt and resistor unit Weston D-83745 (in the main electrical junction box) to measure direct currents from 0 to 50 amperes. When the small button on the face of the voltammeters is pushed, the shunt wiring is disconnected and the instrument is connected through the resistor of the shunt and resistor unit to measure direct current voltages. On some airplanes, the two voltammeters are replaced with two type F-1 ammeters Army 94-32284 wired through the shunt unit Army 94-32204 to measure direct currents from 0 to 150 amperes. A small lamp, controlled by the "COCKPIT LAMPS" switch on the left-hand electrical panel, is mounted above the ammeters (or voltammeters) to aid in reading the instruments.

2. REMOVAL.

a. Remove the screws holding the electrical panel to the fuselage and pull the panel forward.

b. Remove the screw holding the instrument to the panel.

c. Disconnect the leads at the back of the instrument and remove the instrument.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Maintenance will consist of minor repairs that do not require disassembly, such as:

a. Replacement of broken cover glass.

b. Adjustment of pointer to "ZERO."

c. Tightening or replacement of leads.

d. Replacement of instrument or shunt.

4. ADJUSTMENT OF POINTER.

a. Be sure no current is flowing through instrument or shunt.

b. Adjust zero corrector screw on the front of the instrument, while lightly tapping the cover, so that the pointer is exactly at "ZERO."

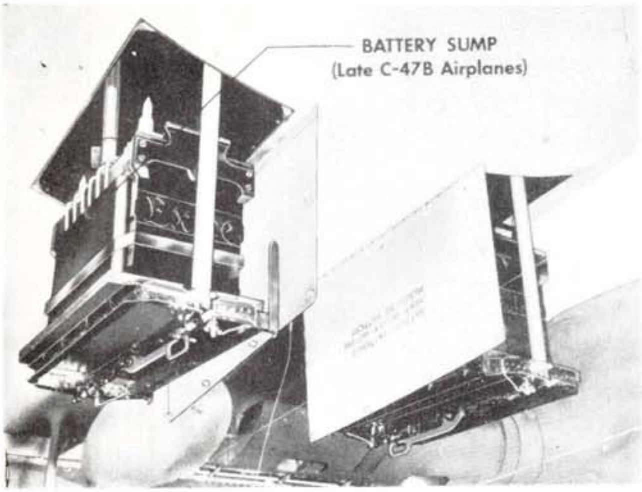


Figure 451—Batteries Installed

c. After once making this adjustment, it will be unnecessary to change it unless the screw is accidentally moved.

5. INSTALLATION. — Reverse procedure as described in paragraph *2.*, removal, preceding. All connections must be clean and tight for correct instrument readings.

(3) BATTERY SYSTEM. *(See figure 448.)*

(a) GENERAL.—The battery system consists of two 12-volt storage batteries, connected in parallel, each controlled by operation of a battery connector relay. Each relay, and thus each battery circuit, is controlled by a battery master switch in the pilots' compartment. Operation of the switches and relays connects the batteries to the fuse bus and the two wing buses. A ground power receptacle is provided for the use of a battery cart when the airplane is on the ground. For the wiring diagram of the battery system, refer to figure 472 (sheet 1).

(b) BATTERIES. *(See figure 451.)*

1. DESCRIPTION.—The two Exide 6FHM-13-1, 12-volt, 85 ampere-hour storage batteries are connected in parallel and installed in the bottom of the forward fuselage, forward of the radio compass loop antenna. Each battery is mounted on a spring-loaded platform and is accessible through a door. The platform can be lowered until the battery is clear of the fuselage and locked in that position by means of a catch on the support tube. Special terminals on the battery, plug into receptacles in the fuselage so that the lowering of the battery disconnects it. A vent tube from the battery case to the fuselage skin is provided to carry battery fumes from the airplane. The battery rack is provided with padding to absorb any overflow from the battery.

2. REMOVAL.

a. Turn off the battery master switch for the battery being removed.

b. Open the battery door by releasing the fasteners holding the battery door closed.

c. Pull out the release handle locking pin.

d. Pull the release handle and the battery platform straight down until the catch on the slide tube engages.

WARNING

The safety catch must be engaged before the battery is removed. The platform is spring-loaded and will snap up and injure the service man if it is not locked down.

e. Loosen the battery clamp and remove the battery.

3. MAINTENANCE REPAIR AND REPLACEMENT.—If the battery terminals are corroded, remove the corrosion by brushing the affected areas thoroughly with a stiff bristle brush (but not wire) and then applying to the terminals a neutralizing solution of baking soda and water. Always keep vent caps in place during cleaning, after which they should be examined to make sure the gas escape holes are clear. For any other maintenance of the battery, refer to test before installation, following.

Note

When the airplane is to be idle for more than one week, remove the battery and turn it in to the battery room for storage where it will be kept fully charged.

4. TEST BEFORE INSTALLATION.

a. Check the specific gravity of each cell with a hydrometer, returning the electrolyte to the cell from which it was removed. Remove the battery from the airplane if the specific gravity is below 1.240 or above 1.310.

b. Check the level of electrolyte in battery cell. The electrolyte level must not be allowed to get below the top of the plates. If it is necessary to add water to the battery, use clean, drinkable water or distilled water as follows:

(1) Fill the self-leveling syringe (in the type D-1 battery servicing kit AAF 40572) with water and insert it into the cell.

(2) Hold the syringe in a vertical position regardless of level of battery and fill the cell.

(3) Withdraw excess water back into the syringe until air is sucked in through hole in syringe tip. This will leave the electrolyte at the proper level.

CAUTION

Do not add water to higher than 3/8 inch above the protector, as too much water above the protector will cause the electrolyte to leak out the vents when the airplane is in operation.

5. INSTALLATION.—Reverse the procedure as described in paragraph *2.*, removal, preceding. Be sure to insert the locking pin after the platform is pushed up into the fuselage.

(c) BATTERY CONNECTOR RELAYS.

1. DESCRIPTION.—Two type B-1 battery connector relays, U.S. Army Specification No. 94-32141, one for each battery circuit, are installed in the main electrical junction box (8, figure 444). The relay is designed to provide a means of remotely controlling each battery circuit by the operation of each battery master switch in the pilots' compartment. The relay consists of a holding coil which, when operated by the opening or closing of the battery master switch, causes the opening or closing of the main contacts connecting the battery with the fuse bus and the nacelle buses. By means of an adjustable screw, the relay holding coil is adjusted to close the main contact at a maximum of 10 volts and to open the main contacts at a minimum of 7 volts. The relay will operate continuously on 14.5 volts d-c.

2. REMOVAL.—Disconnect the leads and the bus connecting the relays. Remove the screws holding the relay to the side of the junction box and remove the relay.

3. MAINTENANCE REPAIR AND REPLACEMENT.—When properly installed and operated, this relay should require little or no attention between overhaul periods.

a. In the event that the battery circuit becomes inoperative, connect a heavy jumper cable across the two heavy contact studs to determine whether or not the relay is at fault. If such is the case, replace the unit.

b. No lubrication is required at any time.

4. TEST BEFORE INSTALLATION.

a. With the relay in a horizontal position, connect the holding coil terminals to a variable d-c supply.

b. Connect a 0 to 50 scale voltmeter across the coil terminals.

c. Connect a test lamp across the heavy switch terminals to indicate the closing of the main contacts.

d. Gradually increase the supply voltage until the main contacts close. This value must be 10 volts at room temperature. If setting is not correct, adjust screw located between main contact terminals. Turn in a clockwise direction to increase closing voltage and in a counterclockwise direction to decrease closing voltage.

e. After the relay has been tested for proper closing voltage, gradually reduce supply voltage from 10 volts until main contacts open. This value must not be less than 7 volts.

f. After relay is adjusted, lock adjusting screw in place by means of lock nut.

5. INSTALLATION.—Reverse procedure as described in paragraph *2.*, removal, preceding.

Note

When installing batteries, the terminal adapter will be torqued to 50 inch-pounds to prevent failure of the terminals.

(d) BATTERY MASTER SWITCHES.

1. DESCRIPTION.—Two C.H. 8201 battery master switches, one for each battery circuit, are installed on the left-hand electrical panel. Each switch operates the battery connector relay holding coil to connect the battery to the electrical system.

2. REMOVAL.

a. Remove the screws, holding the electrical panel to the fuselage and pull forward.

b. Remove the screws holding the switch to the panel.

c. Disconnect the wires at the back of the switch and remove the switch.

3. MAINTENANCE REPAIR AND REPLACEMENT.—Replacement, rather than repair, will be necessary except for tightening loose connections.

4. INSTALLATION.—Reverse procedure as described in paragraph 2., removal, preceding.

(e) EXTERNAL POWER RECEPTACLE PROVISIONS.

1. DESCRIPTION.—A battery cart receptacle is provided on the under surface of the fuselage, aft of the batteries, which automatically connects the external battery to the airplane electrical system when it is plugged in. Both battery master switches should be in the "OFF" position when using an external power source. On airplanes on which the battery cart receptacle is not of the Air Corps type, an adapter, which will make the receptacle correct for Air Corps type battery carts, is installed on early airplanes on the left-hand side of the main cargo compartment, next to the main cargo door, and for late airplanes this is stowed in a clamp on the aileron cable and pulley access door. On early airplanes, the battery cart receptacle is provided with an antiflashback relay which does not connect the battery cart to the airplane electrical system until the plug is pushed completely in, thus preventing an external flash when connecting or disconnecting. This is now furnished with all battery carts.

2. REMOVAL.—The battery cart receptacle may be removed by removing the screw holding it to the side of the receptacle box and disconnecting the attaching terminals and buses. The antiflashback relay is also screwed to the side of the receptacle box. The adapter is stowed by means of a small clamp.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

4. INSTALLATION.—Reverse procedure as described in paragraph *2.*, removal, preceding.

(4) OIL DILUTION SYSTEM.

(a) SOLENOID VALVE. *(See figure 303.)*

1. DESCRIPTION.—One oil dilution solenoid valve, AAF 37D6210, is installed on the forward side of each fire wall. The valve is an electrically operated solenoid valve, controlled by operation of the spring-loaded oil dilution switch in the pilots' compartment. The valve is connected to the fuel pressure line and the fuel supply line to the oil system; the electrical connection is made from the oil dilution switch to the internal terminal post of the valve. Operation of the oil dilution switch actuates the solenoid and allows fuel to flow through the valve. As soon as the switch is released, the valve is returned to the normally closed position by the action of the de-energized solenoid. Refer to paragraph 9, fuel system, this section, for further information on the oil dilution system.

2. REMOVAL.

a. Disconnect and cap the two lines attached to the valve.

b. Remove the lock nut at the end of the valve and lift off the cover assembly, exposing the terminals.

c. Disconnect the wire at the terminal.

d. Remove the nuts holding the valve to the bracket and remove the valve.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement rather than repair, will be necessary.

4. INSTALLATION. — Reverse procedure as described in paragraph *2.*, removal, preceding.

(b) OIL DILUTION SWITCHES.

1. DESCRIPTION.—Two spring-loaded C.H. 8211 oil dilution switches are installed on the left-hand electrical panel (2, figure 443), one for each engine. The switches are wired to power through a 15-ampere fuse in the main junction box. When the switch is held in the "ON" position, the solenoid is energized to open the oil dilution valve. On the airplanes with engine primer valves, one C.H. 8212 switch for each engine is used for both oil dilution and engine primer control.

2. REMOVAL AND MAINTENANCE. — Same as described in paragraphs 14.*b.*(3)*(d)2.* to *5.*, this section.

(5) ENGINE PRIMER SYSTEM.

(a) SOLENOID VALVE.—On some airplanes an engine primer solenoid valve, AAF 37D6210, is installed on the inboard wall of each nacelle, aft of each fire wall. The valves are electrically operated, controlled by operation of the spring-loaded oil dilution engine primer switches in the pilots' compartment. Each valve is connected to the fuel pressure supply line and the primer line, and is similar to the valve used for oil dilution. Refer to paragraph 14.*b.*(5)*(a)* for further description, removal, and maintenance of the solenoid valve. Refer to paragraph 10, this section, for further information on the engine primer system.

(b) ENGINE PRIMER SWITCHES.—On the airplanes with engine primer valves, one spring-loaded switch C.H. 8212, installed on the left-hand electrical panel (2, figure 443), controls the oil dilution and engine primer valves for each engine. Each switch has two spring-loaded positions: "OIL DILUTION" and "ENGINE PRIMER." Refer to paragraphs 14.*b.*(3)*(d)* *2.* to *5.*, this section, for removal and maintenance.

(6) PROPELLER FEATHERING SYSTEM.

(a) GENERAL.—The propeller feathering system consists of the propeller feathering pump motors, control switches, relay, and pressure cut-out switch. The propeller feathering switch operates to connect the pump motor to power through the relay until the pressure cut-out switch breaks the circuit. Refer to propellers, paragraph 7, this section, for further information on the propeller feathering operation.

(b) PROPELLER FEATHERING PUMP.
(See figure 260.)

1. DESCRIPTION.—The two Hamilton Standard propeller feathering pumps 53535, one for each propeller, are mounted on and driven by two 12-volt dc motors located on the forward side of each fire wall. Electrical connections are made to the motor through the terminal box on top of the motor case. The motor brushes are accessible by removing a metal band on the end of the case. Refer to propellers, paragraph 7, this section, for information on the pump.

2. REMOVAL.—Refer to paragraph 7.*d.*(2) *(a)* propellers, this section.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. REPLACEMENT OF BRUSHES.—The brushes may be checked for wear by removing the metal band from the motor. Replace brushes worn to within 1/16 inch of the brush holder. Seat new brushes by holding a piece of No. 000 sandpaper on the curved surface of the commutator and sanding toward the brush. Fold brush leads over so that they touch no metal parts other than the brush holders. Brushes must have sufficient clearance to insure free movement in the holders. Blow all brush dust out of the motor with dry compressed air.

b. SANDING COMMUTATOR. — If the commutator is rough or coated, clean the surface by folding a piece of No. 000 sandpaper over a flat piece of wood and holding it against the curved surface of the commutator while rotating. DO NOT apply more than 12 volts to the motor during sanding operation. DO NOT use emery cloth or metal. If the commutator is too rough or has become eccentric, it must be resurfaced by removing the armature and turning down the surface, cutting it just deep enough to make it true.

4. INSTALLATION.—Reverse procedure referred to in paragraph *2.*, removal, preceding.

(c) PROPELLER FEATHERING SWITCHES.
(See figure 452.)

1. DESCRIPTION.—Two push button propeller feathering switches GE2CC-1A1A, one for each propeller system, are mounted one on each electrical

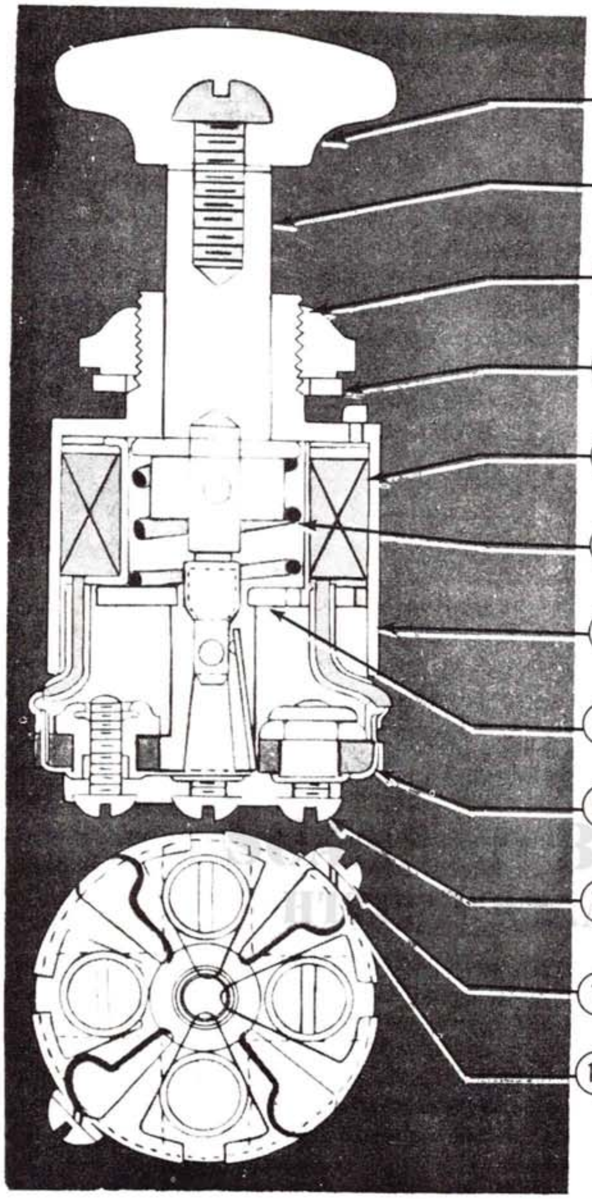


Figure 452—Propeller Feathering Switch

1. Push Button Knob
2. Contact Pin Shaft
3. Retaining Nut
4. Lock Washer
5. Holding Coil
6. Compression Spring
7. Shell
8. Spring Seat
9. Brush Holder
10. Connection Lead Screw
11. Brush Holder Screw
12. Lock Washer

control panel (figure 443). Each switch is used, in conjunction with a propeller feathering relay and a pressure cut-out switch, to control the motor of one of the propeller feathering pumps. The switch is made up of contacts, shaft, and holding coil. When the switch is depressed, the contacts are connected, energizing the propeller feathering pump. At the same time the holding coil is energized and the switch is held down until the pressure cut-out switch opens the holding coil circuit. On some airplanes, the switch is wired to power through a 20-ampere fuse in the main electrical junction box.

CAUTION

> On most airplanes the propeller feathering motor circuit is not fused. If there is no feathering action within 90 seconds, the propeller feathering switch must be opened by pulling out.

2. REMOVAL.

a. Remove the screws holding the electrical panel to the fuselage and pull the panel forward.

b. Remove screws holding switch to panel.

c. Disconnect terminals at back of switch and remove switch.

3. MAINTENANCE REPAIR OR REPLACEMENT.—If the contacts do not make proper contact, they may be bent into adjustment. If the shaft and contact pin stick and bind, lubricate with a few drops of oil, Specification No. AN-O-6. Replace with new switch, rather than attempting to make any other repairs.

4. INSTALLATION.—Reverse procedure as described in paragraph *2.*, removal, preceding.

(d) PROPELLER FEATHERING RELAY.

1. DESCRIPTION.—One Leach 5038 relay is installed in each fire wall junction box, wired in the propeller feathering circuits. This relay, when energized by operation of the propeller feathering switch, energizes the propeller feathering pump motor by connecting it with the battery circuit.

2. REMOVAL.—Disconnect the terminals, remove the attaching screws, and remove the relay from the junction box.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Same as described in paragraph 8.*a.*(5)*(c)*, this section.

4. INSTALLATION.—Reverse procedure as described in paragraph *2.*, removal, preceding.

(e) PRESSURE CUT-OUT SWITCH.
(12, figure 255)

1. DESCRIPTION. — One pressure cut-out switch is mounted on the base of each propeller governor. The switch is a normally closed limit switch, wired in the propeller feathering circuit, which operates to de-energize the holding coil of the propeller feathering switch (and thus to stop the propeller feathering pump motor) when the pressure in the propeller governor reaches 400 psi.

2. REMOVAL.

a. Disconnect electrical plug.

b. Remove screw attaching switch unit to the propeller governor base and remove the switch.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

4. INSTALLATION.—Reverse procedure as described in paragraph *2.*, removal, preceding.

c. INSTRUMENTS, ELECTRICALLY OPERATED.

(1) GENERAL.—The instruments described in the following paragraphs are electrically operated and are therefore discussed in this section. Refer to paragraph 11, instruments, this section for the instrument system as a whole. For the wiring of these electrical instruments, refer to their specific diagrams in figure 472.

(2) CARBURETOR AIR TEMPERATURE GAGE.

(a) DESCRIPTION.—Two Weston 606, type 85 carburetor air temperature indicators, one for each engine, are installed on the electrical instrument panel (right-hand side of the pilots' instrument panel, figure 308). Two Weston D-94177 thermometer resistance bulbs are installed, one in each engine carburetor air scoop. The indicator is connected to the resistance bulb so that changes in the temperature of the carburetor air will be registered on the indicator face by means of changes in the electrical current between the bulb and the indicator. The indicator is calibrated from 0° to 70°C; the cover glass is marked to indicate desirable and undesirable temperatures. The indicator is grounded in the instrument panel junction box, the resistance bulbs are grounded in the engine section pull boxes, and the circuit is wired to power through the 15-ampere temperature gage fuse in the main electrical junction box.

(b) REMOVAL.

1. INDICATOR.

a. Remove screws attaching electrical instrument panel (lower right-hand portion of instrument panel) and pull panel forward.

b. Remove screw attaching instrument to panel.

c. Disconnect electrical leads at back of instrument and remove instrument.

2. RESISTANCE BULB.

a. Disconnect electrical plug.

b. Unscrew and remove resistance bulb.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections or adjusting indicator pointer.

(d) ADJUSTMENTS.—If the instrument pointer is not at its normal zero (37.8°C) adjust the small screw at the front of the instrument. With a small screw driver, rotate the screw slowly towards right or left until the instrument pointer is on 37.8°C.

(e) INSTALLATION.—Reverse procedure as described in paragraph *(b)*, removal, preceding.

(3) ENGINE OIL TEMPERATURE GAGE.

(a) DESCRIPTION.—On C-47A and early C-47B airplanes, two Weston 606, type 109 engine oil temperature indicators, one for each engine, are installed on the electrical instrument panel (right-hand side of the pilots' instrument panel, figure 308). Two Weston D-94177 thermometer resistance bulbs (figure 453) are installed, one in the rear accessory case of each engine. On late C-47B airplanes one Dual Type AN 5795-6 engine oil temperature indicator is used and the oil temperature bulb, AN 5525-1, is located on the oil supply line just aft of the oil dilution fuel line connection. The indicator is connected to the resistance bulb so that changes in the temperature of the engine oil will be registered on the indicator face by means of changes in the electrical current between the bulb and the indicator. The cover glass is marked to indicate desirable and undesirable temperatures. The indicator is grounded in the instrument panel junction box on early C-47A airplanes. On late C-47A and all C-47B airplanes, the indicator is grounded on a terminal strip fastened to the back of the instrument panel. The resistance bulb is grounded in the engine section pull box, and the circuit is wired to power through the 5-ampere temperature gage fuse, or circuit breaker in the main electrical junction box.

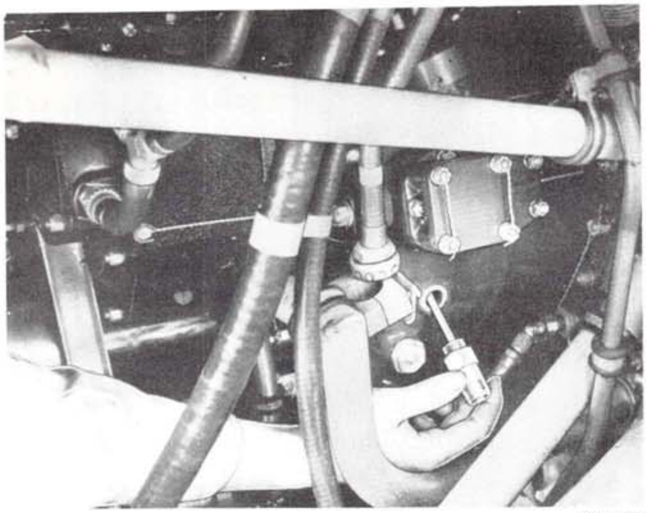


Figure 453—Installing Oil Temperature Gage Resistance Bulb—C-47A and Early C-47B Airplanes

(b) REMOVAL.—Same as described in paragraph 14.*c.*(2)*(b)*, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections or adjusting indicator pointer.

(d) ADJUSTMENTS.—If the instrument pointer is not at its normal zero (110°C), adjust the small screw at the front of instrument. With a small screw driver, rotate the screw slowly towards right or left until the instrument pointer is on 110°C.

(e) INSTALLATION.—Reverse procedure as referred to in paragraph *(b)*, removal, preceding.

(4) FREE AIR TEMPERATURE GAGE.

(a) DESCRIPTION.—One Weston 602, type 58 free air temperature indicator is installed on the electrical instrument panel (right-hand side of the pilots'

instrument panel, figure 308). One Weston D-94177 thermometer resistance bulb protrudes from the under side of the airplane nose. The indicator is connected to the resistance bulb so that changes in the temperature of the outside air will be registered on the indicator face by means of changes in the electrical current between the bulb and the indicator. The indicator is calibrated from −30° to + 50°C. The indicator is grounded in the instrument panel junction box, the resistance bulb is grounded in the fuselage left tunnel, and the circuit is wired to power through the 15-ampere temperature gage fuse in the main electrical junction box.

(b) REMOVAL.–Same as described in paragraph 14.*c.*(2)*(b),* this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary, except for tightening any loose connections or adjusting indicator pointer.

(d) ADJUSTMENTS.–If the instrument is not at its normal zero (0°C), adjust the small screw at the front of the instrument. With a small screw driver, rotate the screw slowly towards right or left until the instrument pointer is on 0°C.

(e) INSTALLATION. – Reverse procedure as referred to in paragraph *(b),* removal, preceding.

(5) ENGINE TEMPERATURE GAGE (THERMOCOUPLE THERMOMETER).

(a) DESCRIPTION.–Two Weston 602, type 31 engine (cylinder head) temperature indicators, one for each engine, are installed on the electrical instrument panel (right-hand side of the pilots' instrument panel, figure 308). Two Weston D-91033 thermocouples are installed, one at cylinder 1 of the right-hand engine and one at cylinder 13 of the left-hand engine. The thermocouple is a copper gasket, with iron and constantan leads, mounted under the spark plug in the cylinder. The indicator is connected to the thermocouple by means of leads of definite length so that changes in the temperature of the engine cylinder will be registered on the indicator face by means of changes in the thermo-electric current between the thermocouple and the indicator. The indicator is calibrated from 0°C to 350°C; the cover glass is marked to indicate desirable and undesirable temperatures.

(b) REMOVAL.–Same as described in paragraph 14.*c.*(2)*(b)*, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary, except for tightening any loose connections or adjusting indicator pointer.

(d) ADJUSTMENTS.–Disconnect one of the thermocouple leads. If the indicator pointer does not indicate the temperature of the airplane compartment (as shown on a high grade thermometer placed near the indicator), reset the pointer by means of the small screw at the front of the instrument.

(e) INSTALLATION. – Reverse procedure as referred to in paragraph *(b),* removal, preceding.

(6) TACHOMETER.

(a) DESCRIPTION.–Two Weston 545, type 54AE tachometer indicators, one for each engine, are installed on the left-hand side of the pilots' instrument panel (figure 308). Two Weston 724, type "C," screw mount tachometer magnetos are installed one on the outboard side of each engine rear section. The magneto is a generator which is directly coupled to the tachometer drive shaft outlet on the engine and which generates a voltage directly proportional to the speed of the airplane engine. The indicator is connected to the magneto so that changes in the engine speed will be registered on the indicator face by means of changes in the electrical current between the magneto and the indicator. The indicator is calibrated from 0 to 3000 rpm.

(b) REMOVAL.

1. INDICATOR.

a. Remove screws attaching indicator to instrument panel.

b. Pull indicator forward, disconnect terminals, and remove indicator.

2. MAGNETO (GENERATOR).

a. Disconnect electrical plug.

b. Hold magneto steady and loosen coupling nut, slide magneto shaft free from engine drive, and remove magneto.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary, except for tightening any loose connections or adjusting indicator pointer.

(d) ADJUSTMENTS.–If the instrument is not at zero (engines "OFF"), adjust the small screw at the front of the indicator. With a small screw driver, rotate the screw slowly towards the right or left until the instrument pointer is on "0" rpm.

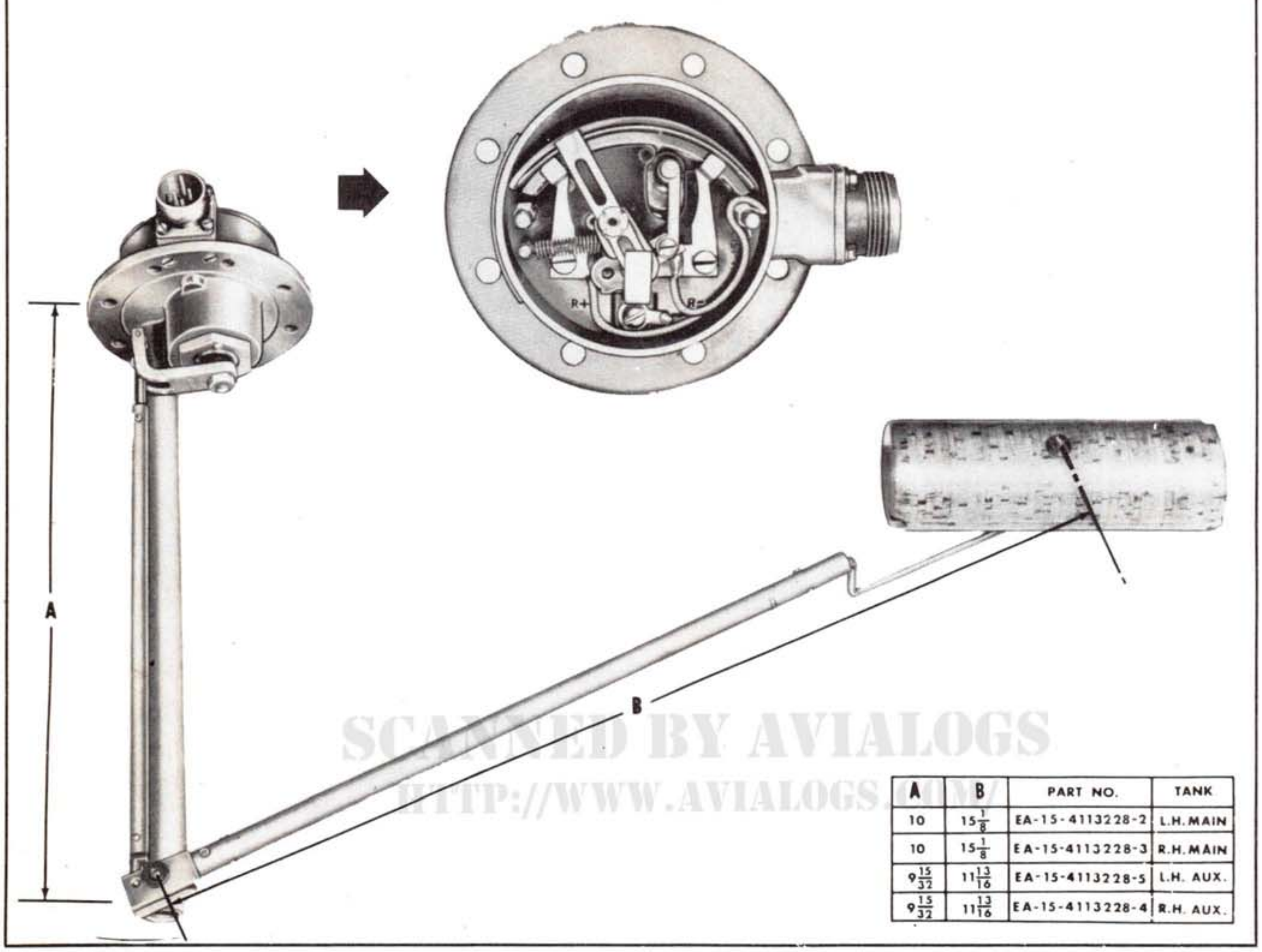
(e) INSTALLATION. – Reverse procedure as described in paragraph *(b),* removal, preceding.

Note

When mounting the tachometer magneto, it is first necessary to align the key on the magneto shaft with the key way on the engine accessory drive shaft. The magneto should be so positioned that the receptacle points in the direction which will permit electrical plug connection.

(7) FUEL QUANTITY GAGE.

(a) DESCRIPTION.–One liquidometer EA-48-5 (12-volt) fuel quantity indicator is installed on the electrical instrument panel (right-hand side of the pilots' instrument panel, figure 308). On the front of the indicator is a four-position selector switch which allows



A	B	PART NO.	TANK
10	$15\frac{1}{8}$	EA-15-4113228-2	L.H.MAIN
10	$15\frac{1}{8}$	EA-15-4113228-3	R.H.MAIN
$9\frac{15}{32}$	$11\frac{13}{16}$	EA-15-4113228-5	L.H. AUX.
$9\frac{15}{32}$	$11\frac{13}{16}$	EA-15-4113228-4	R.H. AUX.

Figure 454—Fuel Quantity Gage Tank Unit

the selection of the dial for the tank desired. Each dial is calibrated from 0 gallon to the capacity of the particular tank. One liquidometer EA-15 (12-volt) tank unit (figure 454) is installed in each of the four fuel tanks. The tank unit consists of a circular housing to which is attached a supporting member on which a float arm pivots. Inside the housing is an adjustable resistance assembly with adjustment screws R— and R+ used for adjusting stroke and end position, a movable contact arm which is connected by leverage to the float arm, and an electrical receptacle. A metal bellows mounted on the housing prevents fuel leakage. A float is attached to the end of the float arm. The tank unit is connected to the indicator so that changes in the amount of fuel in the tank (changes in the position of the float arm) are registered on the indicator face by means of changes in the current between the tank unit and indicator. The gage circuit is wired to power through a 2-ampere fuse in the main electrical junction box; the indicator case and each tank unit housing is grounded.

(b) REMOVAL.

1. INDICATOR.—Same as described in paragraph 14.*c.*(2)*(b),* this section.

2. TANK UNIT.—Before removing tank unit, be certain the fuel tank is empty.

a. Disconnect the plug at the receptacle.

b. Remove the screw holding the tank unit housing to the tank.

c. Pull the tank unit housing, the float arm, and the float through the tank opening.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) ADJUSTMENTS.—The indicator pointer travel can be adjusted by varying the resistance in the gage leads R+ and R— at the tank unit as follows:

1. With the external battery cart disconnected (airplane electrical system "OFF"), the indicator pointer should be below the "EMPTY" graduation on the dial.

2. With external battery cart connected (airplane electrical system "ON"), turn selector switch on indicator to tank to be checked.

3. Check position of float to see that it is resting properly at the bottom of the tank. If float travel cannot be seen, a stroke setting string must be used (the tank unit is supplied with an eye in the float arm so that a string loop can be passed through and used outside the tank for controlling the float).

4. With the float at the bottom of the tank, the indicator pointer should stand at the 0 gallon mark. If not, the R+ adjustment screw in the tank unit housing must be adjusted until the indicator pointer indicates empty.

Note

The adjustment screws can be reached by removing the top of the tank unit housing.

5. Move float to touch the top of the tank lightly. If the indicator pointer does not indicate full capacity fuel quantity, the R— adjustment screw in the tank unit housing must be adjusted until the indicator pointer indicates full.

6. Try top and bottom positions two or three times and readjust if necessary until the indicator pointer travels accurately between the empty and full marks on the indicator dial.

7. Remove stroke setting string, if used.

8. Check and adjust each tank separately in this manner.

(e) INSTALLATION.—Reverse procedure as described in paragraph *(b),* removal, preceding.

Note

When installing a fuel quantity gage tank unit in the fuel tank, paint under and over the tank unit gasket with zinc chromate slushing compound, AAF Specification No. 3595, or equivalent, to prevent leakage.

(f) TEST AFTER INSTALLATION. — Check travel of indicator pointer with tank unit float at extreme positions. If the indicator does not indicate empty and full when the tank unit float is at the bottom and top of the tank, respectively, adjust as described in paragraph *(d),* adjustments, preceding.

(8) PITOT TUBE HEATERS.

(a) DESCRIPTION. — One Pioneer 3202-3S pitot tube heater is installed on each of the two pitot tubes installed below the pilot's compartment, extending from the fuselage. On some airplanes, both heater units are controlled by one switch on the left-hand electrical control panel and wired to power through one 30-ampere fuse (or one 20-ampere fuse for each heater wire and one 50-ampere fuse for the switch) in the main electrical junction box. On some airplanes, each heater unit is controlled by a separate switch ("FORWARD" and "AFT" pitot tube heaters) and wired to power through a separate 20-ampere fuse in the main electrical junction box.

(b) REMOVAL AND MAINTENANCE.—Refer to paragraph 11., instruments, for information on the pitot tube units. Disconnecting the wires to the pitot tubes will disconnect the heater circuit. Replacement, rather than maintenance or overhaul, is necessary, except for checking loose connections. Remove switches as described in paragraph 14.*b.*(3)*(d)2.*, this section.

d. LAMPS. *(See figure 455.)*

(1) GENERAL.—The lamps used in lighting, inside the airplane for the use of the crew members and outside the airplane for recognition and navigation, are described in the following paragraphs. This section is divided into lamps of similar purpose and circuit. The spare lamp box (1, figure 495.) is mounted on the right-hand wall of the pilots' compartment, over the copilot's seat, and contains the following 17 spare lamp bulbs: ten AN3121-1816 bulbs and seven Mazda No. 67 bulbs. One cannon SCF-D-O lamp bulb is installed in the main electrical junction box and is controlled by a C.H. 8410 switch which turns on the lamp when the junction box door is opened. The lamp circuit is connected to the battery side of the right-hand battery disconnect relay. Refer to the lamps list for the type identifications of the bulbs used on this airplane. For the wiring diagrams of the lamp circuits, refer to their specific diagrams in figure 472.

(2) DOME LAMPS.

(a) DESCRIPTION.—Nine Gem City HD-1001 dome lamps using AN3124-1141 bulbs, are installed in the following locations: one in the forward passageway, one in the radio operator's compartment, one in the navigator's compartment (if installed), four in the main cargo compartment, one in the lavatory, and one in the tail compartment. Each lamp, except for the main cargo compartment lamps, is controlled by a CH8201 switch mounted next to the lamp; the main cargo compartment lamps are controlled by either of two CH8210 switches located one at each end of the main cargo compartment ceiling. The dome lamps circuit is wired to power through a 20-ampere fuse in the main electrical junction box; each lamp is grounded to the airplane. The navigator's dome lamp is in a separate navigator's lamp circuit and is wired to power through a 15-ampere fuse in the main electrical junction box.

(b) REMOVAL.

1. Remove screws attaching lens to lamp assembly.

2. Remove lamp bulb.

3. To remove lamp assembly, remove screws attaching lamp panel to ceiling disconnect wires, and remove lamp from panel.

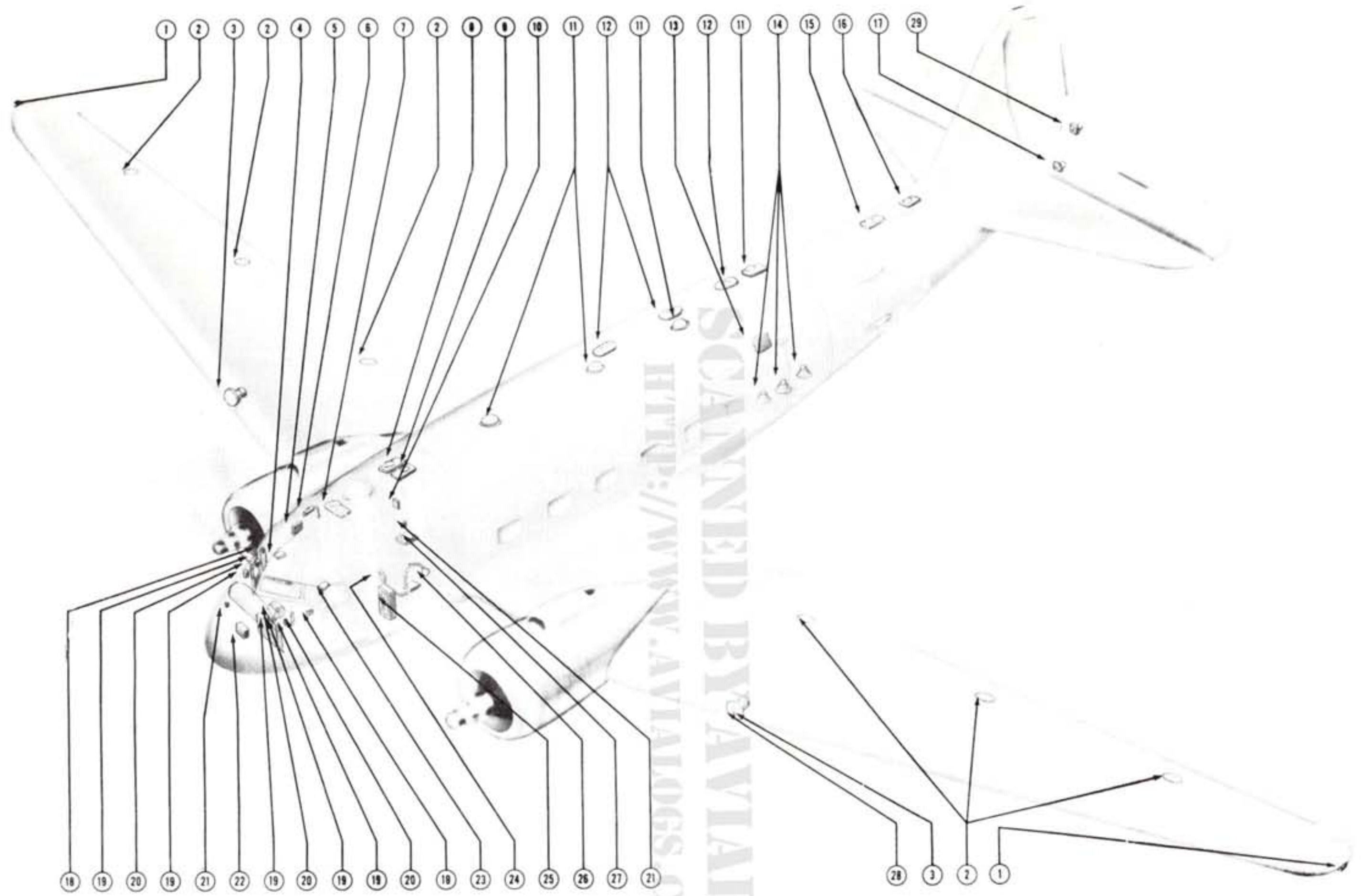


Figure 455—Lamps

1. Wing Tip Position Lamp
2. Wing Formation Lamp
3. Landing Lamp
4. Copilot's Oxygen Pressure Warning Lamp
5. Spare Lamps Box
6. Extension Lamp
7. Forward Passageway Dome Lamp
8. Radio Operator's Dome Lamp
9. Upper Recognition Lamp (on Some Airplanes Only)
10. Radio Operator's Oxygen Pressure Warning Lamp
11. Main Cabin Dome Lamp
12. Fuselage Formation Lamps
13. Parapack Control Box Lamps
14. Lower Recognition Lamps
15. Lavatory Dome Lamp
16. Tail Cone Compartment Dome Lamp
17. Tale Cone Position Lamp—(Early Airplanes)
18. Ammeters (or Voltammeters) Lamp
19. "Dashlite" Lamps
20. Fluodescent Lamps
21. Heating and Ventilating Warning Lamps
22. Fluorescent Auxiliary Lamp Box (or Fluorescent Lamps Inverter)—Early Airplanes
23. Pilot's Oxygen Pressure Warning Lamp
24. Navigator's Oxygen Pressure Warning Lamp
25. Main Junction Box Lamp
26. Navigator's Work Table Lamp
27. Navigator's Compartment Dome Lamp
28. Passing Lamp—Early Airplanes Only
29. Tail Cone Position Lamp—Late Airplanes

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(d) INSTALLATION.—Reverse procedure as described in paragraph *(b)*, removal, preceding.

(3) COMPARTMENT LAMPS.

(a) DESCRIPTION.—Three cockpit dashlite lamps (19, figure 455) using Mazda No. 67 bulbs, are installed one on each side of the pilots' compartment and one on the aft side of the control pedestal. One H. A. Douglas 2948 ammeter lamp (18, figure 455), using a Mazda No. 67 bulb, is installed on the right-hand electrical panel above the ammeters. These four lamps are controlled by a C.H. 8201 "COCKPIT LIGHTS" switch on the left-hand electrical panel on some airplanes, on the right-hand electrical panel on others; the lamps are wired to power through a 15-ampere fuse in the main electrical junction box. A type C-4 extension lamp Army 94-32294 (type C-7, Army 94-32396, on some airplanes) using an AN 3121-1816 bulb, is installed on the aft wall of the pilots' compartment behind the copilot's seat (3, figure 495). The lamp is operated and adjusted by the red knurled rheostat knob at the bottom of the lamp assembly and by the red momentary switch button on top, at the end. The extension lamp is wired to power through a 15-ampere fuse (the interaircraft signal lamp plug circuit) in the liaison and command junction box and is grounded in the copilot's radio junction box. One type A-11 work table lamp AAF 32372 (3, figure 492) using a P/N AN3132-1142 bulb is mounted on the table in the navigator's compartment (if installed). The work lamp is controlled by a C.H. 8201 switch mounted on the navigator's dome lamp panel and is in the separate navigator's lamps circuit, wired to power through a 15-ampere fuse in the main electrical junction box.

(b) REMOVAL.

1. DASHLITE LAMP.—The lamp bulb may be removed by disengaging it from its sockets. To remove the lamp assembly, remove the attaching screws and disconnect the wires.

2. EXTENSION LAMP.

a. Disconnect wires in copilot's radio junction box.

b. Remove screws attaching lamp assembly to mounting bracket and remove lamp.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b)*, removal, preceding.

(4) INSTRUMENT PANEL LAMPS.

(a) DESCRIPTION. — Three dashlite lamps, using Mazda No. 67 bulbs and used for illumination of the instrument panel, are installed one on each forward side of the pilots' compartment and one on the forward side of the control pedestal (19, figure 455). The three dashlites are controlled by the Ohmite 352, model H, 35-ohm, "PANEL LIGHTS" rheostat on the left-hand electrical panel. One AN5734-2 (grain-of-wheat) bulb is installed in each of the following instruments: compass, command receiver tuning control, left side of automatic pilot control, right side of automatic pilot control. A spare AN5734-2 bulb is inserted in the lower part of the compass face. These four instrument lamps are controlled by the Ohmite 352, model H, 175-ohm "COMPASS LIGHT" rheostat on the left-hand electrical panel. Two resistors, one for the compass lamp and one for the instrument lamps, are installed on the back of the left-hand electrical panel. All the above lamps are in one circuit, wired to power through a 15-ampere fuse in the main electrical junction box.

(b) REMOVAL.

1. DASHLITE LAMPS.—The lamp bulb may be removed by disengaging it from the socket. To remove the lamp assembly, remove the attaching screw and disconnect the wires.

2. INSTRUMENT LAMPS. — Any of the grain-of-wheat bulbs may be removed by unscrewing the small bulb knob on the front of the instrument.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b)*, removal, preceding.

(5) FLUORESCENT LAMPS.—Four AN 3038-1 ultraviolet light assemblies are installed, one on each side of the pilot's compartment and two on the control pedestal for the illumination of the instrument panel. (See sheet 8A, figure 472.) Each lamp has a replaceable AN 3125-1 bulb, a lamp starting switch with variable intensity control and an ultraviolet filter.

CAUTION

The ultraviolet energy from these light assemblies is harmless in any permanent form, but they should always be adjusted so that none of the radiation reaches the pilot's eyes.

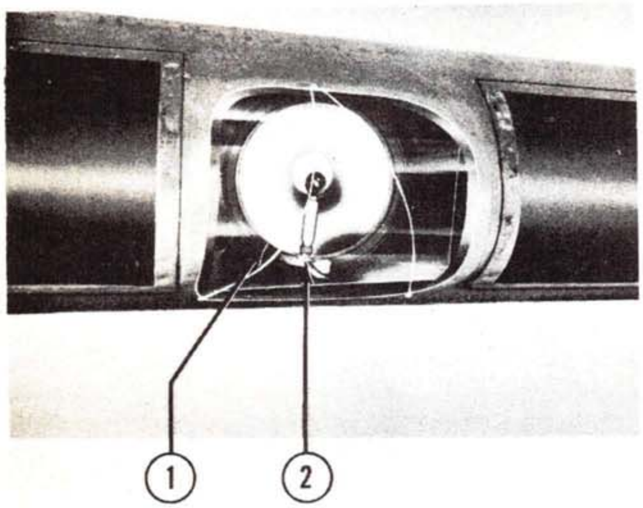


Figure 456—Landing Lamp Installed—Left Wing

1. Landing Lamp
2. Passing Lamp

(6) INTERAIRCRAFT SIGNAL LAMP. — On some airplanes, a Hubbell 7540 receptacle is provided on the aft wall of the pilots' compartment in back of the copilot's seat, in which to plug a type C-3A, 12-volt interaircraft signal lamp Army 94-32288.

(7) LANDING LAMPS. *(3, figure 455.)*

(a) DESCRIPTION.—On C-47, C-47A, and early C-47B airplanes, one Dietz type DO-WSX-LH (and -RH) or type A-9 landing lamp assembly (figure 456) is installed in leading edge of each outer wing panel. Each assembly uses a Mazda G-25, 12-volt, 420-watt, Mogul prefocus base bulb. On late C-47B airplanes a PAR 64 type sealed-beam 24-volt, 600-watt lamp assembly is installed in each wing. The operation of the lamps is controlled by two C.H. 8201 "LANDING LIGHT" switches on the left-hand electrical panel (2, figure 443) and two Leach 5035 relays installed one in each nacelle junction box. Each switch is wired to power through a 20-ampere fuse in the main electrical junction box. Each relay is wired to power through a 35-ampere fuse in each fire wall junction box. When the "LANDING LIGHT" switch is placed in the "ON" position, the landing lamp relay is actuated and is connected to power for operation. When the switch is turned "OFF," the relay is de-energized and the lamp is disconnected. Lamp assemblies are adjusted to project a beam on the ground, approximately 430 feet for the left and 380 feet for the right, in front of the nose on the centerline of the pilot's seat, with the airplane in three point ground position.

(b) REMOVAL.

1. SWITCHES.—Same as described in paragraph 14.*b.*(3)*(d)*2., this section.

2. LANDING LAMP ASSEMBLY.—On C-47, C-47A, and early C-47B airplanes, remove landing lamp bulb through hand hole on top of wing. If necessary to remove lamp assembly, proceed as follows:

a. Remove screws attaching glass panel to wing panel, including the bridle attaching screws.

b. On C-47, C-47A, and early C-47B airplanes, remove screw attaching lamp reflector to wing panel. On late C-47B airplanes remove the retainer ring.

c. Disconnect electrical wires at outer wing junction box and remove lamp assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—In most cases, on C-47, C-47A, and early C-47B airplanes replacement of the bulb and cleaning and polishing of the reflector will be all that is necessary. Clean the reflectors by brushing the dust from the lens with a soft brush. Moisten a piece of cheese cloth with alcohol and dip in dry lamp black. Rub the reflector lightly to loosen the dirt. Allow sufficient time for the mixture to dry and then polish with cheese cloth. If lamp reflector assembly is damaged, replacement will be necessary. On late C-47B airplanes, only replacement of the sealed beam lamp is necessary.

(d) ADJUSTMENTS.—Adjustment of the lamp may be made by working through the hand hole on top of the wing, loosening the clamps holding the lamp assembly, and sliding it to the desired position before tightening down the clamps.

(e) INSTALLATION.—Reverse the removal procedure. Caution should be exercised in reinstalling the LH and RH reflectors inasmuch that they are not interchangeable. Both the left and right reflectors should be installed with manufacturer's name plate down.

(8) POSITION (RUNNING) LAMPS.

(a) DESCRIPTION. — One Grimes model E position lamp A-1285-LH (and -RH), using an AN3122-1512 bulb, is installed in each wing tip (1, figure 455). The lens in the right lamp is green, the lens in the left lamp is red. One type D-2 position lamp Army 94-32266 (17, figure 455) using an AN3121-1816 bulb and a clear lens is installed in the tail cone (on some airplanes, a Grimes type "C" tail lamp is used with a Grimes No. 94 bulb). On some airplanes, all position lamps are controlled by one "RUNNING LIGHTS" (or "POSITION LIGHTS") switch, located on the left-

hand electrical panel (2, figure 443). On C-47, C-47A, and early C-47B airplanes, the wing tip position lamps are controlled by a C.H. 8201 "ON-OFF" switch and the tail cone lamp by a C.H. 8200 "BRIGHT-OFF-DIM" switch, both on the left-hand electrical panel. The "DIM" position of the tail cone lamp switch is wired through an I.R.C. type MW-4, 25-ohm resistor, mounted on the back of the right-hand electrical panel. On late C-47B airplanes, the wing tip position lamps and the tail cone lamp are installed by a C.H. 8200 "BRIGHT-OFF-DIM" switch both on the left-hand electrical panel. The "DIM" position of the wing tip lamp switch is wired through an acker type ohmite, 15-ohm resistor mounted on the back of the right-hand electrical panel. Both lamp switches are in one circuit, wired to power through a 5-ampere fuse in the main electrical junction box.

(b) REMOVAL.—The lamps can be removed by removing the attaching screws. To remove the switches, follow the procedure described in paragraph 14.*b.*(3)*(d)2.,* this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION.—Reverse procedure as described in paragraph *(b),* removal, preceding.

(9) RECOGNITION LAMPS.

(a) DESCRIPTION. — Three type E-2 downward recognition lamps Army 94-32374 (14, figure 455), using an AN3120-1039 bulb, are installed on the underside of the fuselage below the main cargo door. The lenses for the lamps, looking forward are amber, green, and red respectively. One type E-1 upward recognition lamp Army 94-32366 (9, figure 455), using an AN3120-1039 bulb and a clear lens, protrudes from the top of the fuselage, above the radio operator's compartment. The lamps are controlled by four AN3018 switches and a type A-1 keying switch, located on the right-hand electrical panel (5, figure 443). Each of the four switches has three positions: "KEY," "OFF," and "STEADY." When the switch or switches are in the "KEY" position, the lamps may be operated intermittently for code signalling by means of the push-button keying switch. When the switches are in the "STEADY" position, the lamps are turned on steadily and the push button is inoperative. The circuit is wired to power through 20-ampere fuse in the main electrical junction box.

CAUTION

The maximum ground operating time for the recognition lamps is ten seconds.

(b) REMOVAL.

1. UPWARD LAMP.—From outside airplane, one man must remove screws attaching lamp to fuselage. From inside, a second man must disconnect electrical plug and remove lamp assembly.

2. DOWNWARD LAMPS.—From ouside airplane, remove screws attaching lamp to fuselage. Pull lamp out enough to disconnect electrical plug and remove lamp assembly.

3. SWITCHES.—Same as described in paragraph 14.*b.*(3)*(d)2.,* this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b),* removal, preceding.

(10) PASSING LAMP.

(a) DESCRIPTION.—One Mazda No. 1144 natural ruby passing lamp bulb is inserted in an H.A. Douglas No. 1116 socket, mounted in the left-hand landing lamp reflector (2, figure 456). The passing lamp is installed for the purpose of signalling or warning when the airplane is maneuvering. The lamp is controlled by the C.H. 8201 "PASSING LIGHT" switch on the left-hand electrical panel (figure 443); the circuit is wired to power through a 15-ampere fuse in the main electrical junction box. This passing lamp has been deleted on later airplanes.

(b) REMOVAL.—The lamp bulb may be easily removed and replaced through the hand hole on top of wing (above the left landing lamp). If it is necessary to remove the socket, remove the screws attaching the landing lamp glass panel to the wing panel, remove the screws attaching the socket, disconnect the wires at outer wing junction box, and remove socket.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b),* removal, preceding.

(11) WARNING LAMP SYSTEMS.

(a) DESCRIPTION.

1. OIL-PRESSURE WARNING LAMPS.—On some airplanes, two Korry 103-A-RED oil-pressure warning lamps, using AN3121-1816 bulbs, one for each engine oil system, are installed on the right-hand side of the instrument panel (figure 308), above the oil-pressure indicators. Each lamp is controlled by operation of a Pioneer 3122-1 switch, installed on the left-hand side of each fire wall, looking aft. The switch is installed in the oil-pressure indicator line and operates the warning lamp when the oil pressure drops below 50 psi. The oil-pressure warning circuit is wired to power through a 15-ampere fuse in the main electrical junction box; the switches are grounded in the fire wall junction boxes.

2. FUEL PRESSURE WARNING LAMPS.—Two Korry 103-A-RED fuel pressure warning lamps, using AN3121-1816 bulbs, one for each engine fuel system, are installed on the right-hand side of the instrument panel (figure 308), above the fuel pressure indicators. Each lamp is controlled by operation of a Pioneer 3110 switch (figure 457) installed in the center of the forward side of each fire wall. The switch is installed in the fuel pressure indicator line and operates

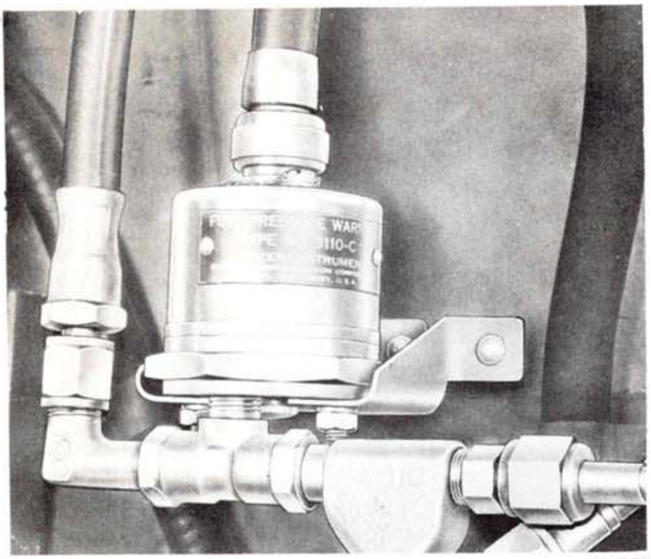


Figure 457—Fuel Pressure Warning Switch Installed

when the fuel pressure drops below 12 psi. The fuel pressure warning circuit is wired to power through a 15-ampere fuse in the main electrical junction box; the switches are grounded in the fire wall junction boxes.

3. LANDING-GEAR WARNING SIGNAL LAMPS AND HORN.—Two landing-gear warning lamp assemblies, using AN3121-1816 bulbs, one Korry 204-BP-RED and one Korry 204-BP-GREEN, are installed on the extreme right-hand side of the instrument panel (figure 308). The warning lamps are "ON" whenever the airplane is not correctly prepared for landing. The warning horn sounds when either throttle is closed and the airplane is not correctly prepared for landing. One micro B-R36 limit switch is installed for each landing gear, attached to a support on the wing front spar in each nacelle. The switch is operated by a lever when the landing gear is in the "LATCHED-DOWN" position. Refer to paragraph 14.*d.*(11)*(e)* preceding, for adjustments of this switch. A dual switch box, through which the throttle cables run, is installed under the floor in the forward passageway. The switch contacts are closed when the throttle is in the low rpm position. One micro B-R36 limit switch is installed in a switch box mounted on the hydraulic control panel, next to the landing-gear control valve handle. The switch is operated when the landing-gear control valve handle is in the "NEUTRAL" position. The red landing-gear warning lamp assembly is "ON" when the landing gear is up, when the landing gear is down and unlocked, or when the landing-gear control valve handle is not in "NEUTRAL." The green landing-gear warning lamp assembly is "ON" when the landing gear is locked down and the landing-gear control valve handle is in "NEUTRAL." The intensity of the warning lamps may be varied by the C.H. 8721K dimming switch mounted on the instrument panel below the warning lamps. The switch connects two resistors, a 15-ohm, Ohmite No. 1007 resistor for the green lamp and a 20-ohm, Ohmite No. 1008 resistor for the red lamp, both mounted in the electrical instrument junction box, into the warning lamps circuit. A Leach 1013 relay, installed in the main electrical junction box, turns on the antenna reel control box warning lamp in the radio operator's compartment if the antenna reel is extended when the airplane is preparing to land (landing-gear control valve handle in "NEUTRAL" and landing gear down). A Delco-Remy K16 type 1329A, 12-volt warning horn is installed on the left wall of the pilot's compartment, to the left of the pilot's seat. The horn sounds if either throttle is in the low rpm position when the landing gear is down and unlatched or up. The warning lamps are wired to power through a 15-ampere fuse in the main electrical junction box; the warning horn is wired to power through a 20-ampere fuse in the main electrical junction box. The right-hand landing-gear limit switch is grounded in the right-hand nacelle junction box.

4. DOOR OPEN WARNING LAMP.—One Korry 103-A-RED door open warning lamp, using an AN3121-1816 bulb, is installed on the extreme right-hand side of the instrument panel (figure 308) to indicate when one of the airplane doors is not correctly locked. One micro R-R36 limit switch is installed on the left-hand wall, looking forward, aft of the pilot's entrance door latch (6, figure 444). One C.H. 8096 switch is installed on the forward cargo door frame; one C.H. 8096 switch is installed on the outside of the fuselage skin, under the aft cargo door hinge (when closed). Each of these switches is operated by the latching action of the door. The red warning lamp is "ON" when any one of the three doors is open or unlatched. The circuit is wired to power through a 15-ampere fuse in the main electrical junction box.

5. PARACHUTE TROOP WARNING LAMPS.—Two warning lamps, one Korry 103-A-RED and one Korry 103-A-GREEN, using AN3121-1816 bulbs, are mounted in a box installed over the forward cargo door. The lamps are controlled by the operation of a C.H. 8200 switch on the pilot's left-hand electrical panel. The switch has three positions: "CAUTION," "OFF," and "JUMP," and is used by the pilot to inform the parachute troops of the proper time to jump from the airplane. The circuit is wired to power through a 15-ampere fuse in the main electrical junction box.

6. PARACHUTE PACK WARNING LAMP.—One Korry 103-A-RED warning lamp is installed on the parachute pack rack control box. Information on this lamp will be found in paragraph 14.*d.*(12) parachute pack rack lamps, preceding.

(b) REMOVAL.

1. LAMPS.—The bulb may be removed by turning and releasing it from the lamp assembly.

2. LIMIT SWITCHES.—Remove attaching screws, disconnect wires, and remove switch.

3. LANDING-GEAR WARNING DIMMING SWITCH.—Remove screws attaching switch to panel. From inside the nose section, disconnect the wire terminals and remove the switch.

4. PARATROOP WARNING SWITCH.—Same as described in paragraph 14.*b*.(3)*(d)2*., this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections and checking adjustment. (See paragraph *(e)*, adjustments, following.)

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b)*, removal, preceding.

(e) ADJUSTMENTS — LANDING-GEAR WARNING SWITCH.—When a new landing-gear warning switch is installed, the following adjustments must be made:

1. With landing gear down and latched, the trip assembly on the mechanical latch piston arm (figure 458) must be adjusted to hold the switch shaft actuating arm in a horizontal position (switch shaft depressed). This may be done by loosening the nut on the trip assembly, moving the trip assembly in the slotted hole, and tightening the nut for the desired position.

2. With the landing gear in the "DOWN" and "UNLATCHED" position (airplane jacked up), adjust the bolt in the truss brace bracket (figure 458) to keep the switch actuating arm in a position which is 7/16 inch from the mechanical latch trip assembly.

3. With the gear in the same position, adjust the switch extension shaft screw (figure 458) to a position which is ⅛ inch from the switch actuating lever.

(12) PARACHUTE PACK RACK LAMPS.

(a) DESCRIPTION.—Six Korry 103-A-GREEN parachute pack rack indicator lamps, using AN3121-1816 bulbs, are mounted on the parachute pack rack control box (figure 608), above the six release switches. When the parapack circuit breaker switch and the parapack master switch are both "ON," the six indicator lamps are "ON." As soon as a pack is released, the lamp (above the pack number on the control box) goes out to indicate that the pack has been released properly. One Korry 103-A-RED warning lamp using an AN3121-1816 bulb, is installed at the bottom of the parachute pack rack control box. The red lamp is "ON" when the parapack circuit breaker is "ON" but the parapack master switch is "OFF." This red lamp must be "OFF" (master switch "ON") in order to release the parapacks. The lamps are connected to power through the 35-ampere parapack release fuse in the main electrical junction box.

(b) REMOVAL.—Any of the bulbs may be removed by removing the lamp cover and releasing the bulb.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b)*, removal, preceding.

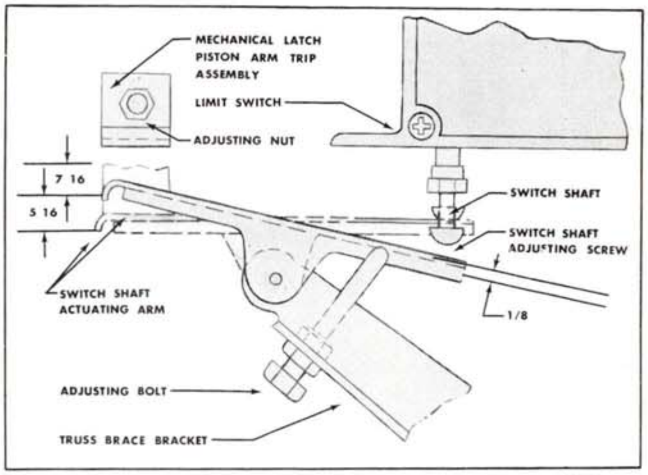

MECHANICAL LATCH PISTON ARM TRIP ASSEMBLY
LIMIT SWITCH
ADJUSTING NUT
7 16
5 16
SWITCH SHAFT
SWITCH SHAFT ADJUSTING SCREW
SWITCH SHAFT ACTUATING ARM
1/8
ADJUSTING BOLT
TRUSS BRACE BRACKET

Figure 458—Landing-Gear Warning Switch Adjustments

e. ICE ELIMINATION, ELECTRICAL.

(1) GENERAL.—Only the electrical units in the ice elimination system are discussed in the following paragraphs. Refer to ice elimination system, paragraph 19., this section, for further information.

(2) PROPELLER ANTI-ICER PUMP MOTOR. *(See figure 574.)*

(a) DESCRIPTION. — The Eclipse type 565-3 (type 744-6, on some airplanes) propeller anti-icer pump is installed on the floor of the pilots' compartment, behind the pilot's seat, and is driven by a two-pole, series wound motor. The pump is mounted on the motor and is driven through a 40:1 worm and wheel gear reduction. The motor is controlled by the C.H. 8201 "PROP DE-ICER" switch, on the left-hand electrical panel (2, figure 443) and the Eclipse 566-1 rheostat mounted on the aft wall of the pilots' compartment behind the pilot's seat. The rheostat is used to regulate the pump output by controlling the speed of the electric motor. The circuit is wired to power through the 15-ampere de-icer equipment fuse in the main electrical junction box.

(b) REMOVAL.

1. PUMP AND MOTOR. — Refer to paragraph 19.*c*.(2)*(c)2*., this section.

2. CONTROL SWITCH.—Same as described in paragraph 14.*b*.(3)*(d)2*., this section.

3. RHEOSTAT.

a. Remove attaching screws.

b. Disconnect the terminals at the back of the rheostat and remove the rheostat.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. MOTOR—Replace brushes if worn to within 1/16 inch of the brush holders. The unit is properly lubricated at the time of manufacture and no further lubrication is necessary except at overhaul. After approximately six months of operation, remove the pump and motor from the airplane and send it to an authorized service depot for overhaul.

2. SWITCH AND RHEOSTAT. – Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. – Reverse procedure as described in pragraph *(b),* removal, preceding.

(3) SURFACE DE-ICER DISTRIBUTOR VALVE MOTOR. *(See figure 556.)*

(a) DESCRIPTION.–One Eclipse 571-4 surface de-icer rotary distributing valve is installed in the forward center wing section and incorporates a driving, shunt wound motor. The rotary valve is connected to the motor drive shaft and is so constructed that it connects one of the de-icer ports to the intake air under pressure from the vacuum pump at the same time that it connects the remaining de-icer ports to the exhaust port. With the motor operating, the valve rotates and each de-icer port is connected in turn to the intake air. A complete cycle of operation to connect all de-icer ports takes about 40 seconds. The operation of the valve and motor is controlled by the cable connected "ON-OFF" control in the aft bulkhead of the pilots' compartment, behind the copilot's seat. When the control is in the "ON" position, the switch contacts (on the valve assembly) are closed and the motor is energized. At the same time, the line from the vacuum pump (and the oil separator) is connected to the distributor valve to be sent to the de-icer ports. When the control is in the "OFF" position, the motor stops and the intake air line from the vacuum pump and the distributor valve de-icer ports are connected to the engine exhaust manifold for dissipation. The valve motor switch is connected to power through the 15-ampere de-icer equipment fuse in the main electrical junction box.

(b) REMOVAL.–Refer to ice elimination system, paragraph 19.*b.*(1)*(e)2.,* this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Replace motor brushes if worn to within 1/16 inch of the brush holders. No lubrication or other maintenance is necessary until major overhaul periods (approximately 60 hours of operation).

(d) INSTALLATION.–Refer to ice elimination system, paragraph 19.*b.*(1)*(e)6.,* this section.

(4) WINDSHIELD ANTI-ICER SOLENOID PULSATING UNIT. *(See figure 574.)*

(a) DESCRIPTION.–The anti-icer system for the two forward windshields incorporates an Acrotorque D-11779, model 300 electric pulsating unit, actuated by a solenoid and mounted in the right-hand baggage compartment, behind one of the liaison radio set tuning units. The solenoid is controlled by the C.H. 8201 "WINDSHIELD DE-ICER PUMP" switch on the left-hand end of the instrument panel (figure 308). When the switch is "ON," anti-icing fluid is pumped by the pulsating action of the automatically connected and disconnected solenoid, from the tank to the outlets on the forward windshield. The amount of fluid sent to the windshields is controlled by a valve control on the left-hand end of the instrument panel. The solenoid circuit is wired to power through a 15-ampere fuse in the main electrical junction box.

(b) REMOVAL.

1. PUMP.–Refer to ice elimination system, paragraph 19.*c.*(1)*(e)2.*b., this section.

2. SWITCH. – Remove screws attaching switch to panel. From inside the nose section, disconnect the wire terminals and remove the switch.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Refer to paragraph 19.*c.*(1)*(e)2.*c., this section.

(d) INSTALLATION. – Reverse procedure as described in paragraph *(b),* removal, preceding.

(5) CARBURETOR ANTI-ICER PUMP MOTOR. *(See figure 563.)*

(a) DESCRIPTION. – On some airplanes, an Adel D-7818, series J-4.0-12V.-D4 motor-driven pump is mounted on the under side of the lower shelf in the right-hand baggage compartment. The pump motor is controlled by the C.H. 8208 "CARB. DE-ICER" switch, mounted on the right-hand electrical panel (figure 443). The switch has three positions: "ON," "MOM.," and "OFF"; the "MOM." position is a spring-loaded position for momentary operation. The circuit is wired to power through a 15-ampere fuse in the main electrical junction box.

(b) REMOVAL.

1. PUMP.–Refer to ice elimination, paragraph 19.*c.*(3)*(c)2.,* this section.

2. SWITCH.–Same as described in paragraph 14.*b.*(3)*(d)2.* this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.

1. PUMP MOTOR. – Same as described in paragraph 14.*e.*(2)*(c)1.,* this section.

2. SWITCH.–Replacement, rather than repair, will be necessary.

(d) INSTALLATION. – Reverse procedure as referred to in paragraph *(b),* removal, preceding.

f. PARACHUTE PACK RELEASE.

(1) GENERAL.–The parachute packs are released from their racks selectively by means of individual parapack switches, individually in order by means of a handswitch, electrically in salvo by means of the pilot's parapack salvo switch, or manually in salvo by means of the pull handle in the main cargo compartment. In order to release the parapacks individually, the master

switch and the circuit breaker switch must both be "ON." By the operation of either the individual parapack switches or the handswitch, the parapacks can then be released. The switches energize the parapack relay and connect the parapack release mechanism to power. When the release mechanism for the parapack being released is operated, the indicator lamp on the control box for that particular parapack goes out and the release circuit is directed to the next parapack rack in order. The pilot's parapack salvo switch energizes the salvo relay which connects all the parapack relays to power simultaneously. When the manual salvo release handle is pulled, a cable is operated which in turn manually actuates all release mechanisms. The parapack control box and parapack relay circuit is wired to power through a 35-ampere fuse in the main electrical junction box. The pilot's salvo circuit is wired to power through a 15-ampere fuse in the main electrical junction box. The control box is protected by the parapack circuit breaker switch which automatically opens the circuit when the current exceeds 15 amperes. For further information on the parachute pack racks, refer to paragraph 1.*d.,* in section V.

(2) PARAPACK RELEASE MECHANISM.

(a) DESCRIPTION.–One type A-3 (RH) bomb release mechanism AAF 24742 is installed for each parachute pack rack. Each bomb release mechanism is attached to a bomb shackle holding a parachute pack and plugged into an auxiliary switch box. The bomb release mechanism consists of levers, springs, trips, and contacts and is electrically actuated by the movement of an internal solenoid. When the solenoid is actuated, the release mechanism levers are opened, opening the bomb shackle levers and releasing the parachute pack. The indicator lamps circuits for the parapack racks are grounded in the release mechanism when it is in the safe or neutral position. When the release mechanism is actuated, the indicator lamp circuit is opened (lamp "OFF") and the parapack release circuit is changed to bypass the release parapack rack and to be directed to the next parapack rack in order. A salvo coupling on the release unit is used for mechanical release of the parapack. Each salvo coupling is held in neutral position by a spring and lever assembly which is controlled by a cable. When the manual salvo handle (next to the parapack control box) is pulled, the cable operates the spring and lever assembly on each release unit and the parapacks are all released.

(b) REMOVAL.

1. With the parapack in the unloaded position, depress the push buttons at each end of the unit to retract the projecting prongs of the two snap fasteners holding the unit to the parapack rack structure.

2. Pull the unit away from the parapack rack structure, disconnecting the plug from the auxiliary switch box.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–This unit must be kept free of oil, dirt, or any other foreign matter. No lubrication is necessary. If the spring on the hinged ear on the release lever is damaged or worn, replace spring. If necessary, replace the ear. Replace any defective snap fasteners. Clean any dirt or corrosion off the electrical plug with emery cloth. Keep internal switching contacts clean by using emery cloth. Check for rough surfaces on lever ends or their corresponding trips. Polish roughened area with emery or crocus cloth.

(d) INSTALLATION. – Reverse procedure as described in paragraph *(b),* removal, preceding.

(3) AUXILIARY SWITCH BOX.

(a) DESCRIPTION.–Each bomb release mechanism is plugged into a Mallory AX-5D auxiliary switch box which is connected to the parapack release circuit. The auxiliary switch box consists of a switch operated by a push button and a plug for the bomb release mechanism. When the release mechanism is plugged into the auxiliary switch box, the push button is pushed in, opening the internal switch, and allowing the current to go through that particular release mechanism, and release the parapack. If the release mechanism is not installed, the internal switch is left closed, and the current is sent directly to the next parapack release mechanism, omitting the parapack rack for which there is no release mechanism.

(b) REMOVAL.

1. Remove the parapack rack as described in paragraph 1.*d.*, section V.

2. Remove the screws attaching the switch box to the parapack rack structure and remove the switch box.

3. The connecting electrical wires may be disconnected by removing the switch box cover.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. – Reverse procedure as described in paragraph *(b),* removal, preceding.

(4) CONTROL SWITCHES.

(a) DESCRIPTION.–The parapack control box (figure 608) is mounted on the left-hand wall of the main cargo compartment, forward of the main cargo doors. On the upper section of the control box are six C.H. 8211 switches and six green indicator lamps, one each for each of the six parapack racks. The switches are used to release the parapacks selectively. When the master switch is "ON" the six green indicator lamps are "ON." As each parapack is released, the indicator lamps go out to indicate which parapacks have been released. On the lower section of the control box are the following: a red warning lamp, a C.H. 8210 master switch, and a C.H. 8752-K4 circuit breaker switch. The circuit breaker switch is used to turn the parapack control circuit "ON" or "OFF" and also automatically dis-

connects the control box when the current exceeds 15 amperes. The master switch is used to connect the parapack control circuit to the parapack release circuit. The red warning lamp goes "ON" when the parapack control circuit is "ON" but the master switch is "OFF." The parapacks cannot be released when the red warning lamp is "ON." An Edwards CS-283 handswitch (figure 608) on an extension cord is clamped to the wall next to the parapack control box. The handswitch is used to release the parapacks, individually in order from No. 1 through No. 6. A guarded spring-loaded C.H. 8211 parapack salvo switch is installed in the pilots' compartment on the left-hand electrical panel (2, figure 443). The salvo switch is used to release all six of the parapacks simultaneously.

(b) REMOVAL.

1. PARAPACK CONTROL BOX.—Remove the screws attaching the cover to the control box. The cover can then be pulled far enough to get to the back. Any of the switches may be removed by removing the attaching screws on the face and disconnecting the wires at the back. The handswitch can be removed by disconnecting the wires inside the control box. The box may be removed by removing the screws attaching it to the side of the fuselage.

2. PILOT'S SALVO SWITCH.—Same as described in paragraph 14.*b.*(3)*(d)2.* this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b),* removal, preceding.

(5) RELAYS.

(a) DESCRIPTION.—Each of the parapack release mechanisms is connected to power by the action of a Leach 1219DE relay. These relays are actuated by the operation of the individual parapack switches, the handswitch, or the pilot's salvo switch. The relays for parapacks 1 through 4 are mounted in the aft parapack junction box; the relays for parapacks 5 and 6 are mounted in the center parapack junction box. One Leach 2036-LB (12-volts) relay is mounted in the center parapack junction box to connect all the parapack release relays to power simultaneously when the pilot's salvo switch is closed.

(b) REMOVAL. — Disconnect wires, remove screws attaching relay to box, and lift out relay.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—The most important servicing item is keeping the contacts clean. All contacts will show burned spots, but these are not to be considered a fault unless they are excessive, in which case use a fine file to clean the contact surfaces. Never use sand or emery paper, because abrasive particles may stay in the contacting area, prevent proper contacting, and cause carbon deposits to form when the contacts open. All other worn parts will necessitate replacement of the relay or new parts if available.

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b),* removal, preceding.

g. MISCELLANEOUS EQUIPMENT.

(1) BAIL-OUT ALARM BELL.

(a) DESCRIPTION. — One Edwards MD-1577 (12-volt) alarm bell is installed on the aft side of forward bulkhead of the main cargo compartment. The bell is controlled by the C.H. 8201 "BAIL-OUT" switch on the left-hand electrical panel. The circuit is wired to power through a 15-ampere fuse in the main electrical junction box.

(b) REMOVAL.

1. ALARM BELL. — Disconnect electrical wires, remove attaching screws, and remove alarm bell.

2. SWITCH.—Same as described in paragraph 14.*b.*(3)*(d)2.* this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b),* removal, preceding.

h. GENERAL—C-47A.—The electrical system on the C-47A airplanes is a 24-volt direct current, single-wire, ground return system.

(1) ELECTRICAL PANELS. *(See figure 442.)*

(a) DESCRIPTION.

1. LEFT-HAND ELECTRICAL PANEL.— The left-hand electrical panel (1, figure 459) is mounted forward of the pilot's seat, above the left windshield. The panel contains the following units: the compass lamps rheostat, the panel lamps rheostat, the left propeller feathering switch, the battery master switch, the two landing lamp switches (left and right), the two position lamp switches (wing and tail), the passing lamp switch, the propeller de-icer switch, the pitot heater switches (forward and aft), the oil dilution and engine primer switches (left and right), the guarded bail-out (alarm bell) switch, the guarded parapack salvo switch, the paratroop warning lamp switch, and the compass lamps resistor (on the back of the panel). On some airplanes, the windshield de-icer pump switch is also mounted on this panel.

2. RIGHT-HAND ELECTRICAL PANEL.— The right-hand electrical panel (9, figure 459) is mounted forward of the copilot's seat, above the right windshield. The panel contains the following units: the two ammeters (left and right), the right propeller feathering switch, the two starter switches (energize-left and right, mesh-left and right), the starter instruction plate, the ammeter lamp, the recognition lamp switches, the cockpit lamps switch, the carburetor de-icer switch, and the position lamps resistor (on the back

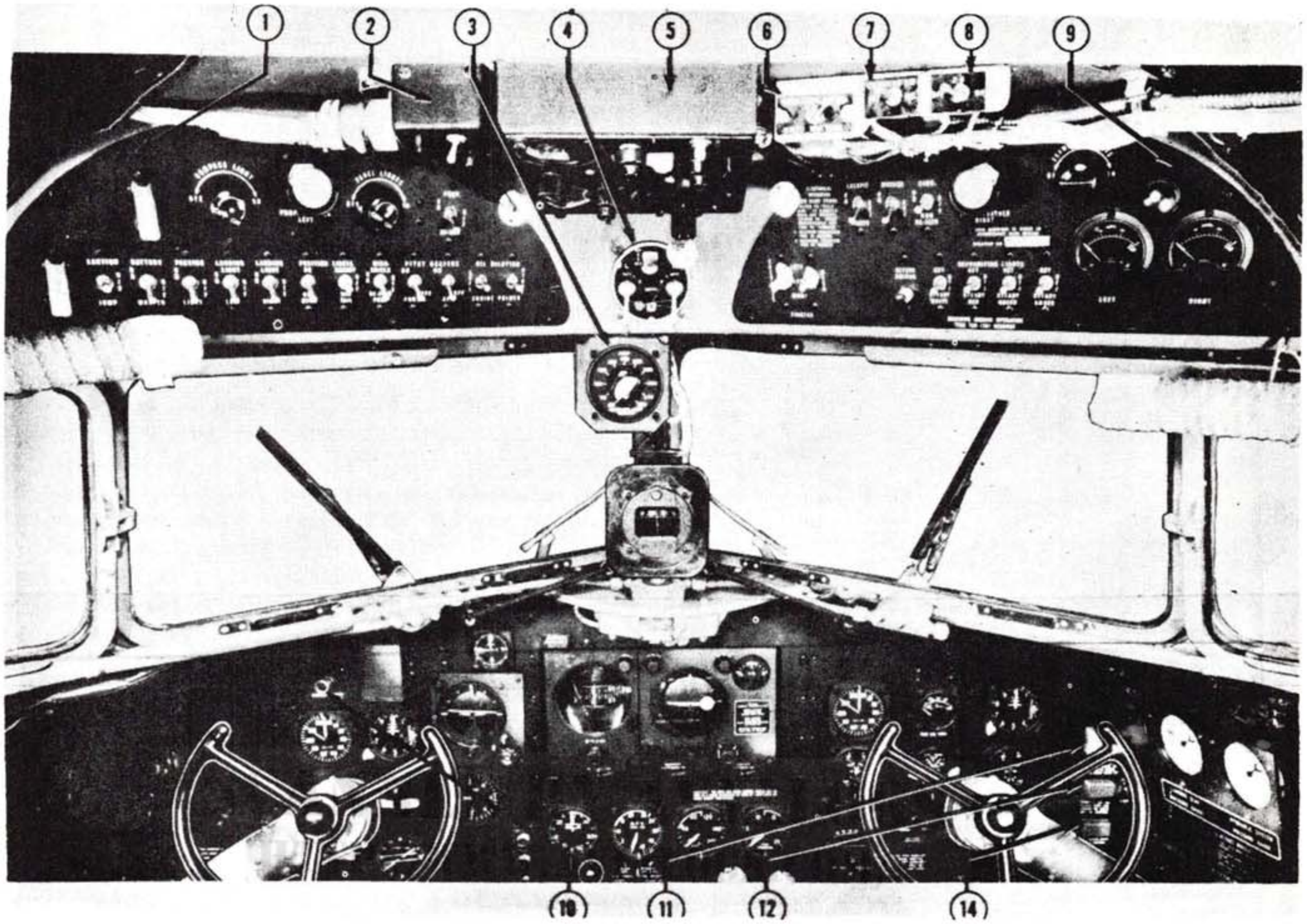


Figure 459—Electrical Panels, Pilots' Compartment (C-47A)

1. Left-hand Electrical Panel
2. RC-103-( ) Radio Control Box
3. Radio Altimeter Limit Switch
4. Ignition Switch Unit
5. Radio Compass Remote Control Box
6. VHF—Medium Frequency Command Sets Selector Switch
7. Radio Compass "CW" Remote Control Switch

*8. AN/ARR-1 Radio Remote Control Switch
9. Right-hand Electrical Panel
10. Marker Beacon Indicator Lamp
11. Pilot's Heating and Ventilating Warning Lamps
12. Landing-Gear Warning Lamps (Red)
13. (Deleted)
14. Landing-Gear Warning Lamps (Green)

of the panel). On some airplanes, the formation lamp switch is installed on this panel.

(*b*) REMOVAL AND MAINTENANCE.—Refer to paragraph 14.*a.*(1)(*b*) and (*c*), this section.

(2) JUNCTION BOXES.—These installations are similar to those described in paragraph 14.*a.*(2) this section, with the following exceptions: The fuselage tunnel junction box and the outer wing junction boxes are not used; in the main electrical junction box (figure 460), only one battery connector relay is installed; on some airplanes, circuit breakers are used in place of fuses.

Note

Circuit breaker switches are designed for the protection of the various circuits and open the circuit when the current exceeds the current capacity of the switch. The circuit breakers must be reset manually, but will continue to open the circuit until the damaged circuit is repaired. In an emergency, the circuit breaker switch may be held "ON" (circuit closed), even though it is dangerous to the circuit, equipment, and circuit breaker. Circuit breakers will burn out and become useless if too great a current, such as a direct shorting, is is sent through it.

(3) WIRING.

(*a*) DESCRIPTION.—The wiring system on the airplane is centralized for connection at the fuse bus (or circuit breaker bus) and at the two nacelle buses. Power is supplied to the airplane electrical system

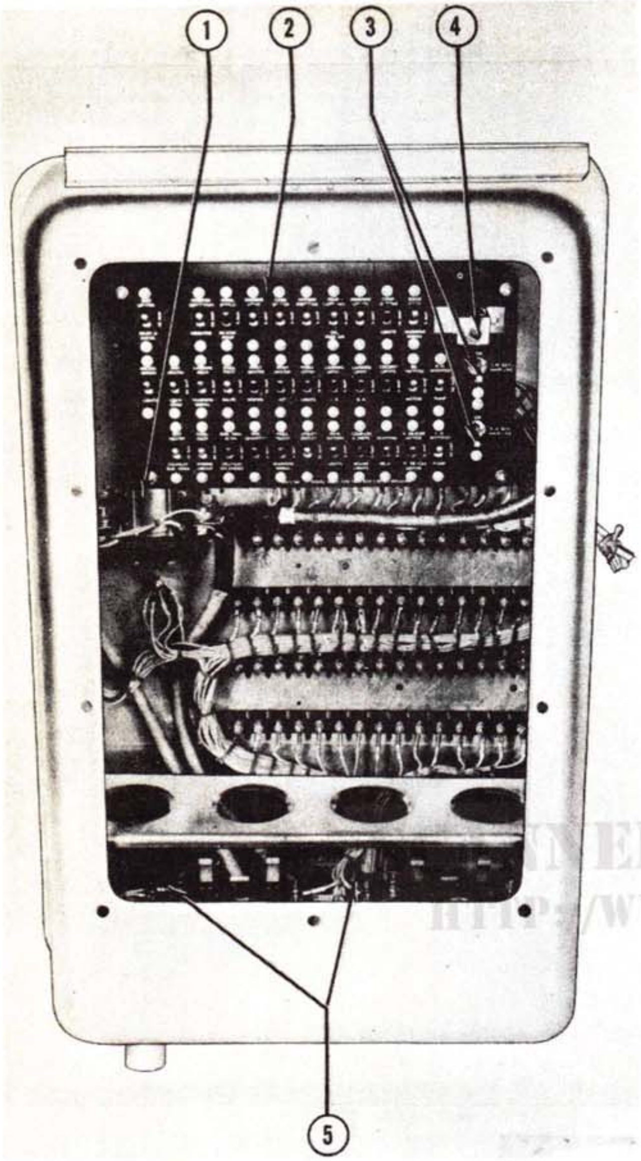


Figure 460—Main Electrical Junction Box (C-47A)

1. Battery Connector Relay
2. Circuit Breaker Panel
3. Generator Main Line Switches
4. Junction Box Lamp Switch
5. Voltage Regulator Mounts

through fuses (or circuit breakers) connected to the bus on the main electrical junction box or through relays connected to the buses in the fire wall junction boxes. All wiring from the fuselage to either wing is connected through terminal strips in the left-hand tunnel. Only the wiring from the engine section is provided with conduit. The wiring for the individual circuits of the airplane electrical system is given in the wiring diagrams at the end of this paragraph. These wiring diagrams must be referred to for the removal or replacement of any electrical units. Refer to paragraphs 14.*a.*(3)*(b)* and *(c)*, this section, for further information.

i. POWER PLANT ELECTRICAL SYSTEM.
(See figure 461.)

(1) GENERAL.—Electrical circuits closely associated with the power plant section of the airplane are discussed in this paragraph. The ignition system, which except for the booster (induction vibrator) circuits is a separate system, is discussed in paragraph 6., power plant, this section. Included in this paragraph are the generator system, the battery system, the oil dilution system, the engine primer system, and the propeller feathering system. The engine starter system is discussed in paragraph 8., this section.

(2) GENERATOR SYSTEM. *(See figure 448).*

(a) GENERAL.—The generator system is the source of power for operating the electrical equipment on the airplane and for charging the two batteries. The two generators are connected in parallel and are directly driven by the airplane engines. Each generator circuit includes either a generator control panel (incorporating a voltage regulator and reverse-current relay) or a separate voltage regulator and reverse current relay. The voltage regulators are used to maintain a constant voltage output of the generator and in equalizing the load of the two generators. A generator resistor is incorporated in the system to achieve the voltage drop necessary for the voltage regulator operation. The reverse-current relay operates to close the main line circuit at a given generator voltage and to open the circuit at a given reverse current (when the battery voltage exceeds approximately 26 volts), thus preventing the battery from supplying power to the generator. A condenser is wired in the generator circuit (on some airplanes only) to eliminate interference to radios. Adjustment of the voltage regulators and reverse-current relays must be made by qualified personnel only. Two ammeters are installed in the pilots' compartment to measure the current in the circuit. The connection of the generator system to the fuse bus (and to the battery system) is made by closing the main line generator switches in the main junction box. For the wiring diagram of the generator system, refer to figure 472 (sheet 2).

(b) GENERATORS.—The generators (5, figure 461) installed on the C-47A airplanes are 28-volt, 50-ampere, Eclipse type 314-15 or 28-volt. 100-ampere type O-1, generators, U.S. Army Specification No. 95-32274 are installed on the C-47B airplanes. With the exception of the type, the information given for the C-47 airplanes in paragraph 14.*b.*(2)*(b)*, this section, may be used.

(c) GENERATOR CONTROL PANEL. – On the airplanes using the Eclipse type 314-15 generators, two type B-1B generator control panels are installed. The information given for the C-47 airplane in paragraph 14.*b.*(2)*(c)* may be used for the B-1B generator control panel with the exception of the type, the voltage to which the regulator is set, the cut-in and drop-out values of the relays, and the voltage of the bus. Ad-

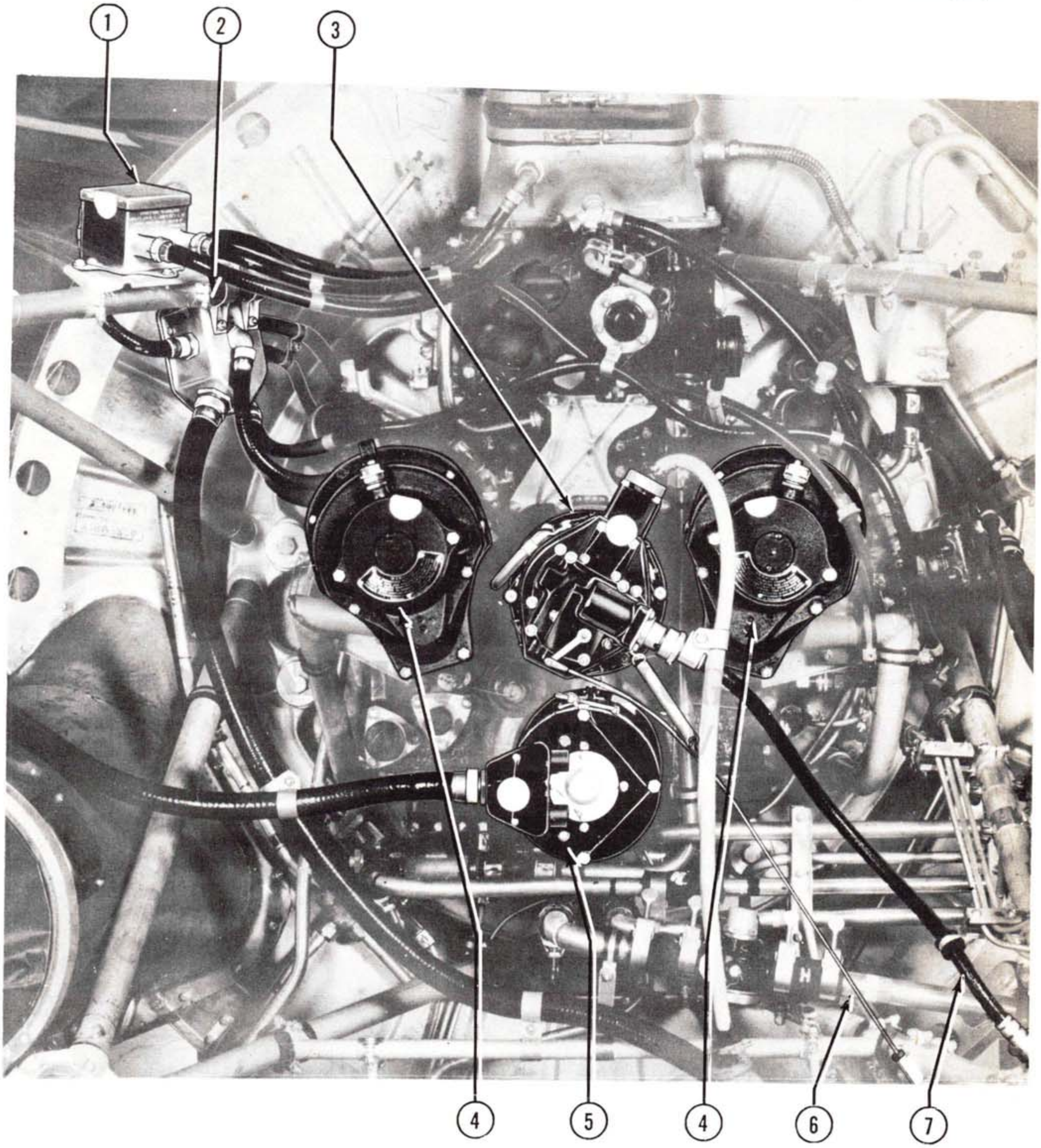


Figure 461—Power Plant Electrical System (C-47A)

1. Induction Vibrator
2. Engine Section Pull Box
3. Engine Starter
4. Magneto
5. Generator
6. Starter Manual Meshing Cable
7. Starter Hand Crank Flexible Shaft

just the regulator on B-1B control panels to 28 volts. The bus voltage should not exceed 28.5 volts. The cut-in value for the relay on the B-1B control panel is 26.5 ±.5 volts and the drop-out should occur between −8 and −25-amperes reverse current.

(*d*) VOLTAGE REGULATOR.
(*See figures 462 and 463.*)

1. DESCRIPTION.—On the airplanes using the type 0-1 generators, two generator voltage regulators U.S. Army Specification No. 94-32276, one for each

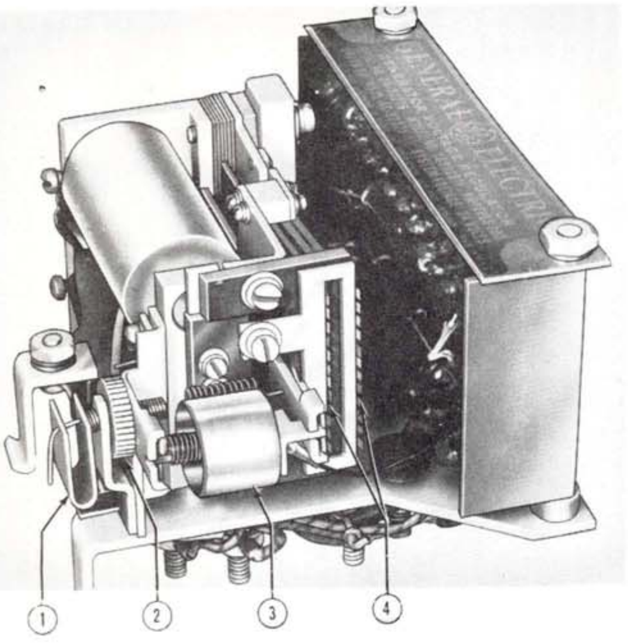


Figure 462—General Electric Voltage Regulator

1. Stud and Temperature Compensator
2. Voltage Adjusting Nut
3. Dashpot
4. Contact Fingers

generator, are mounted in the main electrical junction box (figure 460). On all C-47A and some C-47B airplanes ventilation for the voltage regulators is provided by a tube leading from the main junction box, below the voltage regulators, to the underside of the forward fuselage, forward of the left-hand battery. The tube outlet is partially covered by a small fairing. On late C-47B airplanes ventilation for the voltage regulators is provided by a tube leading from the outboard side of the main junction box to a half section venturi secured to the left side of the forward fuselage. The airstream creates a vacuum at the outlet and draws air from the main junction box. The voltage regulators control the generator voltage by varying the resistance in the field circuit of the generators. The regulators are adjusted to hold the generator voltage at 28 volts.

2. REMOVAL.

a. Remove the cover of the main electrical junction box by removing the attaching screw.

b. Remove the cover plate over the regulators.

c. Lift the two spring clips holding the regulator to the base.

d. Tilt the regulator forward and lift it from the base.

Note

The voltage regulators are precision instruments and must be handled carefully.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. No oil or grease should be used on any part of the voltage regulators.

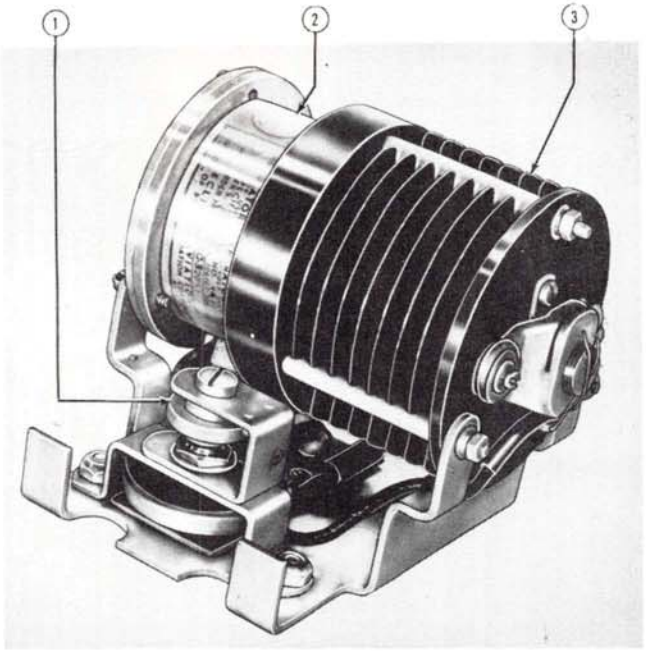


Figure 463—Carbon Pile Voltage Regulator

1. Adjusting Knob
2. Solenoid Case
3. Carbon Pile Housing

b. Internal disassembly and repair will be accomplished at service depots.

c. Whenever a voltage regulator must be adjusted for proper voltage and for paralleling, adjust as described in paragraph 4., adjustments, following.

4. ADJUSTMENTS AND PARALLELING.

a. DC POWER SYSTEM ADJUSTMENT. Warm up both engines and the auxiliary power plant also. The generators and voltage regulators should be at operating temperature before making adjustments. However, due to inadequate engine cooling, the warm-up on the ground will be governed by the limitations of the engines and final adjustment made in the air.

(1) Turn both generator switches to the "OFF" position.

(2) Using a portable precision voltmeter, connect the positive lead to "B" terminal of the voltage regulator and the other lead to a good ground (aircraft structure). Voltmeter, stock No. 7800-961000, is satisfactory for voltage adjustment.

(3) Increase the engine speed of the generator being checked to normal cruising rpm. Operate the remaining engines at idling speed.

(4) The voltmeter should indicate exactly 28.0 volts. If not, adjust the voltage regulator to give a reading of 28.0 on the voltmeter by turning the knurled adjusting knob. Turning the knob to the right (clockwise) will increase the voltage, and turning it to the left (counterclockwise) will decrease the voltage. In aircraft which are operating in areas where the average ambient temperatures are high, voltage may be set as low as 27.25 volts, in lieu of 28.0 volts. Such areas will be identified by the average battery condition in the area. If considerable boiling of bat-

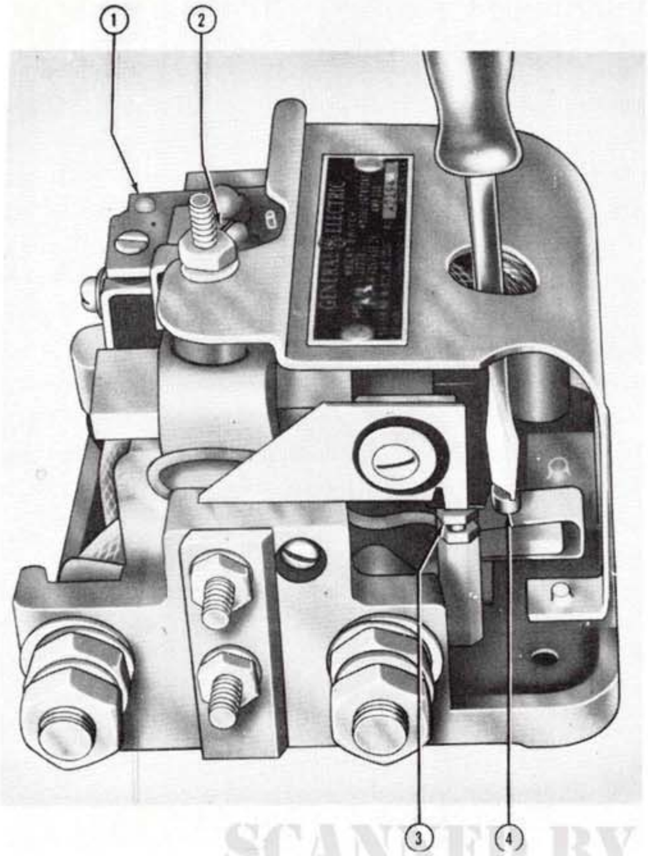


Figure 464—General Electric Reverse-Current Relay

1. Main Contactor
2. Spring Adjustment Screw
3. Armature Stop Adjustment Nut
4. Reverse-Current Adjustment Screw

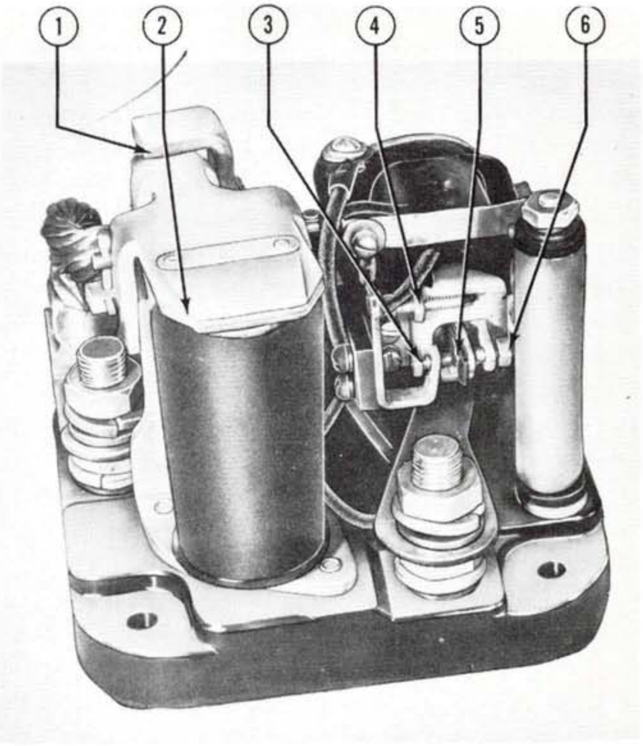


Figure 465—Westinghouse Reverse-Current Relay

1. Main Contactor Contacts
2. Magnetic Contactor
3. Contact Screw
4. Armature Spring Adjusting Screw
5. Relay Contacts
6. Stop Screw

tery electrolyte is encountered and if frequent adding of battery water is required, the generator voltage will be adjusted lower to prevent boiling of battery electrolyte, but never lower than 27.25 volts.

(5) After the regulator is adjusted, reduce the engine speed to idling.

(6) Repeat this procedure for adjusting both voltage regulators and also the regulator for the auxiliary power plant.

(7) If the auxiliary power plant generator is paralleled with the engine driven generators, adjust the voltage regulator to the same voltage as that of the engine driven generators. If it is not paralleled with the engine driven generators, adjust the voltage regulator of the auxiliary power plant generator one volt below the engine driven generator voltage. Determination of whether or not the unit is paralleled can be made by examining the "D" and "K" terminals of the auxiliary power plant generator voltage regulator. If no wires are connected to those two terminals, the unit is not paralleled.

b. PARALLELING ADJUSTMENT.

(1) After completing the voltage adjustment as prescribed, increase the speed of both engines to normal cruising rpm. Operate the auxiliary power plant and place the throttle control lever in the "RUN" position, if the auxiliary power plant generator is paralleled with the engine driven generator.

(2) Close both generator switches.

(3) Apply a load such as lighting equipment, inverters, radio equipment, etc., equivalent to approximately one-half the full load rating of one generator. In some aircraft the ratio of generator capacity to normal aircraft electrical load is so great that it may be difficult to turn on sufficient equipment to obtain the necessary load. This is due to combat equipment not being connected. In instances of this type, turn on as much equipment as possible.

(4) Observe the ammeters. The difference between the highest and lowest generator current should not exceed 10 amperes. A difference of 10 amperes represents a difference of one division for 100-ampere generators. If the generators are not dividing the load properly, first lower the voltage of the high generator and slightly raise the voltage of the low generator by adjusting the corresponding voltage regulator. Counterclockwise rotation of the rheostat will lower the voltage and clockwise rotation will increase the voltage. Do not change the voltage to any great extent. These adjustments will be made only by competent personnel, such as an electrician, engineer, or pilot.

(5) After all adjustments have been completed, make a final check of bus voltage from positive bus to ground, with the precision voltmeter. The volt-

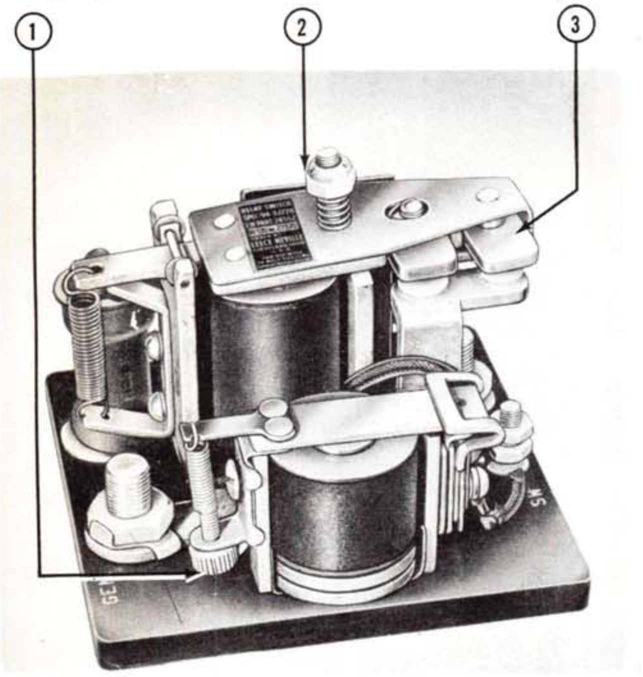


Figure 466—Leece-Neville Reverse-Current Relay

1. Voltage Adjustment Screw
2. Reverse-Current Adjustment Nut
3. Main Contactor Contacts

meter should read 28.0 ± .25 volts if the original generator voltage was adjusted to 28.0 volts, or 27.25 ± .25 volts if the original generator voltage was adjusted to 27.25 volts. If the bus voltage is not within these limits, readjust voltage regulators and then recheck the generator paralleling.

Note

> Always remove system load before reducing engine rpm or removing generators from the power distribution system. A final check of bus voltage level and paralleling should be accomplished after both generators and regulators have been operating approximately ½ hour. The regulators must be thoroughly warm to obtain an accurate check. If the regulators are in good condition, periodic adjustments, as prescribed by aircraft inspection requirements, normally will be the only maintenance required. However, daily observation and trimming adjustments for paralleling will be made as required.

c. DC POWER SYSTEM ADJUSTMENT IN FLIGHT.

(1) During the first flight following the ground adjustment, ammeters will be observed for unequal generator load division. The load applied shall be as specified in paragraph b. *(3)* above or to a greater value. Generator load equalization is not as important with light loads as it is with heavy loads. Also, generator paralleling efficiency will be less with light loads than with heavy loads. If the difference between the high generator and the low generator currents exceeds 20 amperes, lower the voltage of the high generator. A difference of 20 amperes represents a difference of two divisions for 100-ampere generators. To prevent fine adjustments in flight, heavy loads should be used for checking generator paralleling.

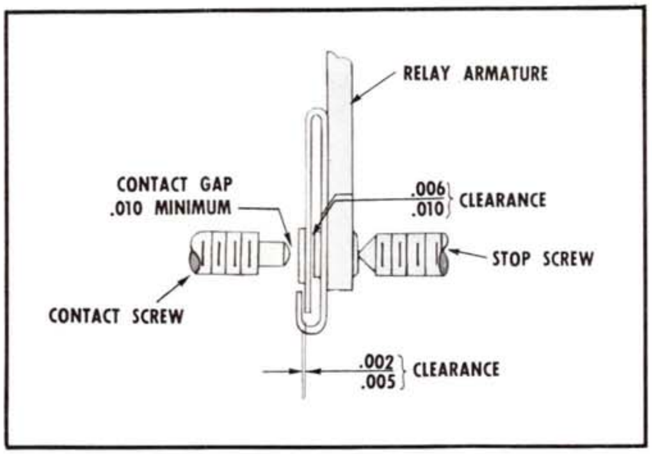


Figure 467—Reverse-Current Relay Contact Adjustment

(2) After the preceding adjustments have been completed, make a final check of bus voltage from positive bus to ground with the precision type voltmeter. The voltmeter should read 28.0 ± 40 volts if the original generator voltage was adjusted to 28.0 volts, or 27.25 + .40 —.25 volts if the original generator voltage was adjusted to 27.25 volts. If the bus voltage is not within these limits, readjust both voltage regulators.

Note

> When adjusting voltage regulators for voltage, do not open both generator switches at one time. Open only the one which is being adjusted. Then close it and proceed to the next switch.

5. INSTALLATION.

a. When securing the regulator to the base, first place the clips on the bottom of the regulator in the slotted brackets on the base. Then while holding the regulator up with the left hand, place the thumb of the right hand on the NUT WHICH SECURES THE NAME PLATE AT THE FRONT OF THE REGULATOR and place the fingers beneath the base. Squeeze with the hand until the spring clip on the base falls into the catch on the regulator. There are two clips so the operation must be repeated at the other end of the regulator.

b. If the left-hand clip is secured first, the installation will be easier.

c. Be sure that the spring clips have settled all the way into the trough of the catch.

CAUTION

> When installing the regulator, do not press on the name plate, as this will bend and damage the resistor housing. Press on the nuts at either end of the name plate.

d. Install the other regulator in the same manner.

e. Install the shield assembly over the regulators and fasten the four studs.

(e) REVERSE-CURRENT RELAY.
(See figures 464, 465 and 466.)

1. DESCRIPTION.—On the airplanes using the type 0-1 generators, the generator reverse-current relay, U.S. Army Specification No. 94-32278, is mounted on the aft outboard side of each fire wall. The relay operates to connect the generator to the electrical distribution system when the generator reaches 26 or 27 volts, and to disconnect the generator from the system when a minimum of 8 and a maximum of 25 amperes reverse current flows from the battery to the generator. That is, if the generator voltage becomes lower than that of the fuse bus (battery), as when the generator has stopped, the relay will open to prevent the battery from supplying power to the generator.

2. REMOVAL.

a. Remove the cover over the relay by removing the fasteners.

b. With the generator main line and battery switches "OFF," disconnect the wires from the terminals on the relay.

c. Remove the screws at the relay base and remove the relay.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Internal disassembly and repair will be accomplished at service depots.

b. Whenever a reverse-current relay is replaced by a new or reconditioned unit, the new relay unit must be adjusted for correct closing voltage as described in paragraph *4.*, adjustments, following.

c. Use no lubrication of any kind on either the bearings or the contacts.

4. ADJUSTMENTS.—After both voltage regulators have been completely adjusted as described in paragraph 14.*i.*(2)*(d)4.*, this section, adjust the reverse-current relay as follows:

Note

Any adjustments of this unit must be made by qualified personnel only.

a. Connect the positive terminal of a portable precision voltmeter to the "GEN." terminal of the reverse-current relay and ground the negative terminal to the airplane structure.

b. Turn on the generator switch and gradually raise the generator speed until a current reading is noted on the ammeter on the copilot's switch panel. As a pilot's check the engine rpm should be between 1000 and 1500.

c. Read the voltage at which the main contactor (1, figure 465) closes. This voltage is ideally 26.5 volts, but may be permitted to vary between 26 and 26.5 volts.

Note

There will be a voltage drop just after the contact closes. The highest voltage observed before the contacts close is to be considered the closing voltage.

d. If the closing voltage is less than 26 volts or more than 26.5 volts, adjustments should be made. If suitable test equipment or a test stand with an electric motor driven generator is available, remove the relays from the airplane and make the following adjustments:

(1) GENERAL ELECTRIC RELAY, PART NO. 3GTR72A1A.—Adjustment of the closing voltage is made by turning a small screw in a spring clip which is attached to the mounting base of the relay. Through the hole in the lower right-hand portion of the name plate, insert a screwdriver; turn the screw clockwise to raise the closing voltage or turn it counterclockwise to lower the closing voltage (figure 464).

(2) LEECE-NEVILLE RELAY, PART NO. 24552.—Adjustment of the closing voltage is made by increasing or decreasing the tension on a spring that is controlled by a knurled head screw located near the generator terminal. Turn the screw counterclockwise to increase the tension on the spring or turn it clockwise to decrease the tension (figure 466).

(3) WESTINGHOUSE RELAY, PART NO. 1240224A.—Adjustment of the closing voltage is made by turning a small screw to adjust the position of the armature inside the small coil. Turning the screw in lowers the closing voltage and turning it out raises the closing voltage (figure 465).

e. After the relay has been adjusted, the reverse current release value of each relay will be checked as follows:

(1) With battery switch "ON," operate the engine so that the ammeter shows current output from generator. A battery cart may be used in place of the airplane's batteries.

(2) Using a center reading ammeter, slowly reduce engine rpm and watch the ammeter needle. The ammeter reading will decrease to zero and then begin to read in the reverse direction. Note the current reading just before the pointer returns to zero. This reading should be between —8 and —20 amperes.

(3) With the battery switch open, the voltage reading may drop as low as eight or nine volts before the reverse current relay opens. This, however, is not critical because the relay has a retarded action. The engine rpm should be 1500 or under.

(4) If the ammeter pointer does not return immediately to zero, advance the throttle until the ammeter shows a small current output from the generator, and readjust the relay.

f. Repeat procedure for reverse-current relay in other nacelle.

5. INSTALLATION.—Reverse procedure described in paragraph 2., removal, preceding.

6. FINAL TEST AFTER INSTALLATION.—Check and adjust relay as described in paragraph *4.* adjustments, preceding.

(f) GENERATOR RESISTOR.—An Avia type 1050 or 1051 generator resistor is installed on the aft wall of each fire wall, above the fire wall junction box (figure 469). Refer to paragraph 14.*b.*(2)*(d)*, for information on this resistor.

(g) CONDENSER.—On some airplanes, two CA 275X condensers are mounted in the fire wall junction box for the power circuit. Refer to paragraph 14.*b.*(2)*(e)*, this section for further information.

(h) GENERATOR MAIN LINE SWITCHES.—Two C.H. 8269 (or C.H. 8701K2) generator main line switches, one for each generator, are installed in the main electrical junction box (3, figure 460). Refer to paragraph 14.*b.*(2)*(f)*, this section, for further information.

(i) AMMETERS.—Two type F-1 ammeters, U.S. Army Specification No. 94-32284, are mounted on the right-hand electrical panel to measure direct currents from 0 to 150 amperes. Each instrument is wired through the 150-ampere ammeter shunt, U.S. Army Specification No. 94-32204, mounted in the main electrical junction box. With the exception of the type numbers, the information given for the C-47 airplane in paragraph 14.*b.*(2)*(g)* this section, may be used.

(3) BATTERY SYSTEM. *(See figure 448.)*

(a) GENERAL.—The battery system consists of two 12-volt storage batteries, connected in series, controlled by operation of a battery connector relay. The relay, and thus the battery circuit, is controlled by the battery master switch in the pilots' compartment. Operation of the switch and relay connects the batteries to the fuse bus and the two wing buses. A ground power receptacle is provided for the use of a battery cart when the airplane is on the ground. Refer to figure 472 (sheet 1) for the wiring of the battery system.

(b) BATTERIES. *(See figure 451.)*—Two Exide 6FHM-13-1, 12-volt, 85 ampere-hour storage batteries are connected in series and installed in the bottom of the forward fuselage, forward of the radio compass loop antenna. With the exception of the fact that the batteries are connected in series for the 24-volt electrical system, the information given for the C-47 airplanes in paragraph 14.(3)*(b)*, this section, may be used.

1. BATTERY SUMP.—On late C-47B airplanes, a sump is installed on each battery. These sumps consist of a cap assembly over each vent which has an over-run tube into a container strapped to the side of each battery. With the exception of emptying these containers, there should be no maintenance on the sump assemblies. For installation of these sumps see figure 451.

(c) BATTERY CONNECTOR RELAY.

1. DESCRIPTION.—One type C-1, U.S. Army Specification No. 94-32183 or one type B-4, U.S. Army Specification No. 94-32324, battery connector relay is installed in the main electrical junction box (1, figure 460). The relay is designed to provide a means of remotely controlling the battery circuit by the operation of the battery switch in the pilots' compartment. The relay consists of a holding coil which, when energized or de-energized by the battery switch, causes the closing or opening of the main contacts which connect the batteries to the airplane electrical system.

2. REMOVAL.

a. Disconnect all leads.

b. Remove screws attaching relay to side of junction box and remove relay.

3. MAINTENANCE REPAIR OR REPLACEMENTS.—When properly installed and operated, this relay should require little or no attention between overhaul periods.

a. In the event that the circuit controlled by this relay becomes inoperative, connect a heavy jumper cable across the two heavy contact studs to determine whether or not the relay switch is at fault. If such is the case, replace the relay.

b. No lubrication is required at any time.

4. TEST BEFORE INSTALLATION.

a. With the relay in a horizontal position, connect the holding coil terminals to a variable d-c supply.

b. Connect a 0 to 50 scale voltmeter across the coil terminals.

c. Connect a test lamp across the heavy switch terminals to indicate the closing of the main contacts.

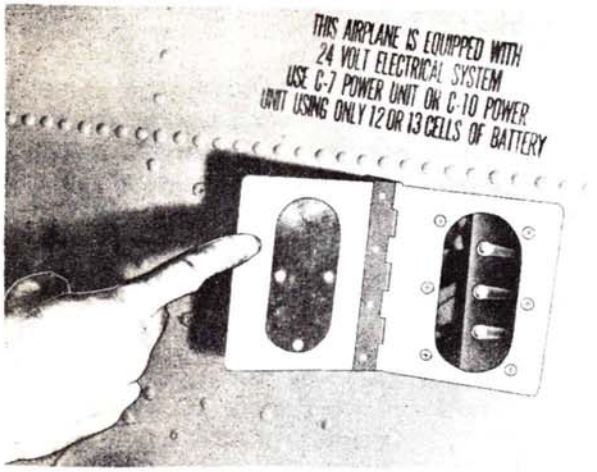

THIS AIRPLANE IS EQUIPPED WITH
24 VOLT ELECTRICAL SYSTEM
USE C-7 POWER UNIT OR C-10 POWER
UNIT USING ONLY 12 OR 13 CELLS OF BATTERY

Figure 468—External Battery Receptacle

d. Gradually increase the supply voltage until the main contacts close. This value must be 18 volts, or less, at room temperature.

e. Gradually reduce the voltage from the closing value and note voltage at which switch contacts open. This value must not be more than 7 volts.

f. If none of these values can be obtained, replace the relay.

5. INSTALLATION.—Reverse procedure as described in paragraph 2., removal, preceding.

(d) BATTERY MASTER SWITCH.—One C.H. 8201 battery master switch is installed on the left-hand electrical panel (1, figure 459). The switch operates the battery connector relay holding coil to connect the batteries to the electrical system. Refer to paragraph 14.*b*.(3)*(d)*, this section, for further information.

(e) EXTERNAL POWER RECEPTACLE PROVISIONS.—Refer to paragraph 14.*b*.(3)*(e)*, this section and to figure 468.

(4) OIL DILUTION SYSTEM.—The oil dilution system on the C-47A airplanes is similar to the system on the C-47 airplanes except that on some airplanes, a 10-ampere circuit breaker is wired in the system in place of the 15-ampere fuse. Refer to paragraph 14.*b*. (4) this section.

(5) ENGINE PRIMER SYSTEM.—The engine primer system on the C-47A airplanes is similar to the system on the C-47 airplanes except that on some airplanes, the engine primer solenoid valve is mounted on the forward side of each fire wall, next to the oil dilution solenoid valve. Refer to paragraph 14.*b*.(5) this section.

(6) PROPELLER FEATHERING SYSTEM.—One Hamilton Standard 54772 propeller feathering pump (figure 260), driven by a 24-volt dc motor, is mounted on the forward side of each fire wall. Two G.E. 2CC1B1 (or H.S. 54267) propeller feathering switches (figure 452) are installed, one on each electrical panel for the operation of the pumps. The switches operate the pumps through Leach 5058 (or type B-8, U.S. Army Specification No. 94-32324) relays, mounted one in each fire wall junction box. A pressure cut-out switch (12, figure 255), mounted on the base of each propeller governor, opens the propeller feathering circuit when the pressure in the propeller system reaches 400 psi. With the exception of the part types, the information given for the C-47 airplanes in paragraph 14.*b*.(6) this section, may be used.

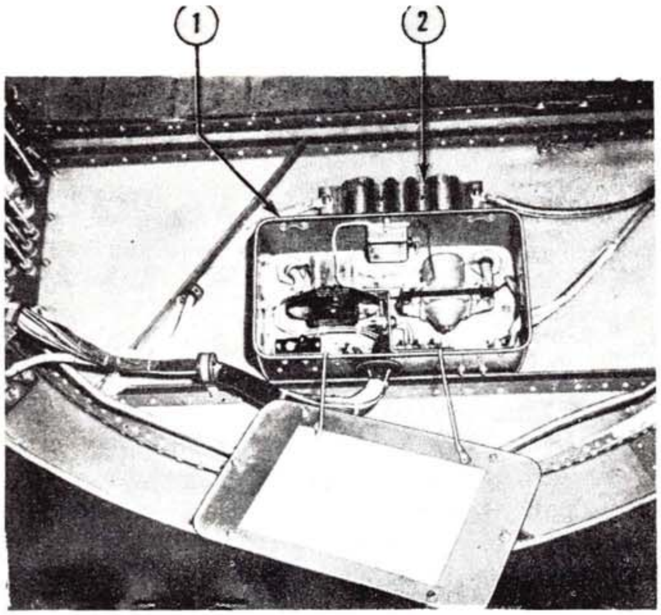


Figure 469—1. Fire Wall Junction Box and 2. Generator Resistor

(7) FUEL BOOSTER PUMP MOTOR.—On some airplanes, one Delco A4949 motor is mounted on each of the two fuel booster pumps installed in the center wing section. The motor is a 24-volt, d-c, 1/8-horsepower, series wound reversible motor. Operation of the fuel booster pump is controlled by the two fuel booster pump switches on the right-hand electrical panel. The switches are wired to power through 20-ampere circuit breakers in the main junction box. Maintenance will consist of replacement of brushes when worn to within 1/16 inch of the brush holder or replacement of the entire motor.

j. INSTRUMENTS, ELECTRICALLY OPERATED.

(1) GENERAL.—Electrically operated instruments are described in this paragraph. Refer to paragraph 11., instruments, this section, for the instrument system as a whole. For the wiring of these electrical instruments, refer to their specific diagrams in figure 472.

(2) CARBURETOR AIR TEMPERATURE GAGE.

(a) DESCRIPTION.—One dual carburetor air temperature indicator (AN 5795-6) is installed on the right-hand side of the instrument panel (figure 309). Two thermometer resistance bulbs (AN 5525-2) are in-

stalled, one in each engine carburetor air scoop. On some airplanes, two thermometer resistance bulbs (AN 5525-1) are used. The indicator is connected to the resistance bulbs so that changes in the temperature of the carburetor air will be registered on the indicator face by means of changes in the electrical current in the circuit between the bulb and the indicator. The indicator is calibrated from —70° to +150°C for each engine; the cover glass is marked to indicate desirable and undesirable temperatures. On some airplanes the indicator is grounded in the instrument panel junction box and on other airplanes the indicator is grounded to the terminal strip mounted on the back of the instrument panel. The resistance bulbs are grounded in the engine section pull boxes and the circuit is wired to power through the 5-ampere circuit breaker (or 15-ampere fuse) in the main electrical junction box.

(b) REMOVAL.

1. INDICATOR.

a. Remove screws attaching instrument to panel.

b. Pull instrument forward, disconnect wires at the back, and remove the instrument.

2. RESISTANCE BULB.

a. Disconnect electrical plug.

b. Unscrew and remove resistance bulb.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. — Reverse procedure as described in paragraph *(b)*, removal, preceding.

(3) ENGINE OIL TEMPERATURE GAGE.

(a) DESCRIPTION. – On C-47A and early C-47B airplanes, two Weston 606, type 109 engine oil temperature indicators, one for each engine, are installed on the electrical instrument panel (right-hand side of the pilots' instrument panel, figure 308). Two Weston D-94177 thermometer resistance bulbs (figure 453) are installed, one in the rear accessory case of each engine. On late C-47B airplanes one Dual Type AN 5795-6 engine oil temperature indicator is used and the oil temperature bulb, AN 5525-1, is located on the oil supply line just aft of the oil dilution fuel line connection. The indicator is connected to the resistance bulb so that changes in the temperature of the engine oil will be registered on the indicator face by means of changes in the electrical current between the bulb and the indicator. The cover glass is marked to indicate desirable and undesirable temperatures. The indicator is grounded in the instrument panel junction box on early C-47A airplanes. On late C-47A and all C-47B airplanes, the indicator is grounded on a terminal strip fastened to the back of the instrument panel. The resistance bulb is grounded in the engine section pull box, and the circuit is wired to power through the 5-ampere temperature gage fuse, or circuit breaker in the main electrical junction box.

(b) REMOVAL.–Same as described in paragraph 14.*j*.(2)*(b)*, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION. – Reverse procedure as described in paragraph *(b)*, removal, preceding.

(4) FREE AIR TEMPERATURE GAGE.

(a) DESCRIPTION.–One free air temperature indicator (AN 5790-6) (type C-11, U.S. Army Specification No. 94-27949 on some airplanes) is installed on the right-hand side of the instrument panel (figure 309). One thermometer resistance bulb (AN 5525-1) protrudes from the underside of the airplane. The indicator is connected to the resistance bulb so that changes in the temperature of the outside air will be registered on the indicator face by means of changes in the electrical current between the bulb and the indicator. The indicator is calibrated from —70° to +150°C. On some airplanes the indicator is grounded in the instrument panel junction box and on other airplanes the indicator is grounded to the terminal strip mounted on the back of the instrument panel. The resistance bulb is grounded on lower nose sta. No. 40 and the circuit is wired to power through the 5-ampere circuit breaker (or 15-ampere fuse) in the main electrical junction box.

(b) REMOVAL.–Same as described in paragraph 14.*j*.(2)*(b)*, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION.–Reverse procedure as referred to in paragraph *(b)*, removal, preceding.

(5) ENGINE TEMPERATURE GAGE
(THERMOCOUPLE THERMOMETER).

(a) DESCRIPTION.–One dual type B-11 engine (cylinder head) temperature indicator, U.S. Army Specification No. 94-27971-B on C-47B airplanes (and two Weston 602, type 31 indicators on C-47A airplanes) is installed on the right-hand side of the instrument panel (figure 309). On C-47 and C-47A airplanes, Weston D-102143 with Weston type indicators are installed, one at cylinder 1 of the right-hand engine and one at cylinder 13 of the left-hand engine. On C-47B airplanes, the Weston D-102143 thermocouples are replaced by two Lewis 8T30B thermocouples. The thermocouple is a copper gasket, with iron and constantan leads, mounted under the spark plug in the cylinder. The indicator is connected to the thermocouple by means of leads of definite length so that changes in the temperature of the engine cylinder will be registered on the indicator face by means of changes in the thermoelectric current between the thermocouple and indicator. The indicator is calibrated from 0° to 350°C; the cover glass is marked to indicate desirable and undesirable temperatures.

(b) REMOVAL.–Same as described in paragraph 14.*j*.(2)*(b)*, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Service maintenance shall consist of the following minor replacements which do not require disassembly of the indicator, but which should be accomplished by trained personnel.

1. Replacement of leads.

Note

The correct length of leads which are to be replaced must be maintained and the cut ends soldered to the connector fittings. This is necessary to maintain correct resistance.

2. Replacement of thermocouple.

3. Adjustment of indicator pointer (refer to paragraph *(d),* adjustment, following).

4. Replacement of indicator or entire installation.

(d) ADJUSTMENT-INDICATOR POINTER. —With the engine cold, place a check thermometer near the thermocouple. Set the indicator pointer to the temperature (as recorded by the check thermometer) by means of the adjusting screw on the indicator face.

Note

The indicator pointer may be adjusted by the following alternate method:

1. Open the circuit at the thermocouple or by disconnecting the indicator.

2. The temperature registered on the indicator should be the same as that of the pilots' compartment. Compare with check thermometer.

3. If not the same, set pointer by means of adjusting screw on indicator face to agree with thermometer reading.

(e) INSTALLATION. — Reverse procedure as described in paragraph *(b),* removal, preceding.

Note

The thermocouple leads must not be lengthened or shortened as they are of definite resistance which enters into the calibration of the instrument. All connections must be clean and tight; otherwise, contact resistance will be added and indicator reading will be incorrect. The connectors to the thermocouple must be taped to prevent shorting to the engine.

(6) TACHOMETER.—The tachometer system consists of one dual indicator (AN 5530-2) (Army 94-27355 on some airplanes) or two type E-9A, E-13, or Weston 602, type 31 single indicators mounted on the instrument panel (figure 309) and a screw mount tachometer generator (AN 5531-2) (Weston 724, type C on some airplanes) mounted on each engine. The tachometer generator is directly coupled to the tachometer drive shaft outlet and is mounted on the outboard side of the engine. When the engine shaft is rotated, the shaft of the tachometer generator rotates and produces three phase electric power which is transmitted to the synchronous motor inside the indicator unit. As the speed of the engine changes, the speed of the tachometer generator changes, causing a corresponding change in the speed of the synchronous motor of the indicator. The dual indicator face is calibrated to indicate the revolutions per minute (0 to 4500) of both engines, there are two indicator pointers, one marked "L" and the other "R." The single indicators are calibrated as follows: type E-9A from 0 to 3500 rpm, type E-13 from 0 to 4500 rpm, and Weston 606, type 31 from 0 to 3000 rpm. With the exception of the part numbers, the information given for the C-47 airplanes under paragraph 14.*c.*(6), this section, may be used.

(7) FUEL QUANTITY GAGE.—One liquidometer EA-48-5 (24-volt) fuel quantity indicator is installed on the right-hand side of the instrument panel (figure 309) to be used with the liquidometer EA-15 (24-volt) tank units (one in each tank) to indicate the quantity of fuel in each tank (figure 454). With the exception of the indicator type, the information given for the C-47 airplanes in paragraph 14.*c.*(7) this section, may be used.

(8) PITOT TUBE HEATERS.

(a) DESCRIPTION.—One type D-2 pitot tube heater Army 94-27874 is installed on each of the two pitot tubes installed below the pilots' compartment, extending from the fuselage. Each heater unit is controlled by a separate C.H. 8201 switch (FORWARD and AFT pitot tube heaters) on the left-hand electrical panel. Each circuit is wired to power through a 10-ampere circuit breaker (20-ampere fuse on some airplanes) in the main electrical junction box; both circuits are grounded in the left-hand fuselage tunnel.

(b) REMOVAL AND MAINTENANCE.—Refer to paragraph 11., instruments, for information on the pitot tube units. Disconnecting the wires to the pitot tubes will disconnect the heater circuit. Replacement, rather than repair or overhaul, is necessary, except for checking loose connections. Remove switches as described in paragraph 14.*b.*(3)*(d)2.,* this section.

(9) REMOTE READING MAGNETIC COMPASS (on some airplanes only).

(a) DESCRIPTION.—The remote reading magnetic compass system consists of two indicators (AN 5730-6) mounted one on the pilots' instrument panel (figure 309) and one in the navigator's compartment (8, figure 492) and the compass transmitter (AN 5730-3), mounted in the right-hand wing, outboard of the landing lamp. The system is a self-synchronous method of electrically transmitting voltages from a coil in the remotely located transmitter to the coils in the indicators. This permits the magnetic element of the compass (in the transmitter) to be installed in a place as free as possible from local magnetic disturbances. The compass system is connected to the airplane inverters (through the inverter relay panel), for the supply of alternating current needed for operating the system, and is grounded in the main electrical junction box. The indicator face has a pointer which moves across the face, showing the direction of flight, and an indicating pointer, controlled by a knob in the lower left-hand corner of the indicator, for setting to the desired course.

(b) REMOVAL.

1. Through the access hole in the top of the wing, disconnect the screws and nuts attaching the compass transmitter to the mount.

2. Through the access hole on the under side of the wing, disconnect the electrical plug and pull the compass transmitter from the mount out of the wing.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections. Compass units which are determined to be malfunctioning must be sent to service depots for inspection and overhaul.

(d) ADJUSTMENTS—SWINGING COMPENSATING.—Refer to paragraph 11.*f.*(2), this section.

(e) INSTALLATION. — Reverse procedure as described in paragraph *(b),* removal, preceding.

k. LAMPS. *(See figure 455.)*

(1) GENERAL.—The lamps used in lighting, inside the airplane for the use of the crew members and outside the airplane for recognition and navigation, are described in the following paragraphs. This section is divided into lamps of similar purpose and circuit. The spare lamp box (1, figure 495) is mounted on the right-hand wall of the pilots' compartment, over the copilot's seat, and contains the following spare lamp bulbs: 18 AN3121-313 bulbs, and one Mazda No. 308 bulb. One cannon SCF-D-O lamp bulb is installed in the main electrical junction box and is controlled by a C.H. 8410 switch which turns on the lamp when the junction box door is opened. The lamp circuit is connected to the battery side of the battery disconnect relay. Refer to the lamps list for the type identifications of the bulbs used on this airplane. For the wiring diagrams of the lamp circuits, refer to their specific diagrams in Figure 472.

(2) DOME LAMPS.—On some airplanes, the nine Gem City HD-1001 dome lamps installation is similar to that described for the C-47 in paragraph 14.*d.*(2), this section, except that AN3124-307 bulbs are used. On other airplanes, the dome lamp installation is similar to the above reference with the following changes: The control switches for the dome lamps are limited to the following switch and two rheostats: a C.H. 8201 tail compartment lamp switch; an Ohmite type 352, 25-ohm, 100-volt rheostat in the forward passageway which controls the radio operator's compartment dome lamp, the forward passageway dome lamp, and the navigator's work table lamp; and one Ohmite type 352, 15-ohm 150-watt rheostat at the forward end of the main cargo compartment which controls the four main cargo compartment dome lamps and the lavatory dome lamp. On these airplanes, the fuses are replaced by a 5-ampere circuit breaker for the forward dome lamp circuit and a 10-ampere circuit breaker for the aft lamp circuit.

(3) COMPARTMENT LAMPS. — The compartment lamps installation is similar to that described for the C-47 airplanes in paragraph 14.*d.*(3), this section, except for the following changes: Mazda No. 303 bulbs are used in the cockpit dashlight lamps and the ammeter lamp; a Mazda No. 308 bulb is used in the navigator's type A-11 work table lamp; an AN3121-1818 bulb is used in the type C-4 extension lamp; on some airplanes, the cockpit lamps circuit is wired to power through a 6-ampere circuit breaker instead of the 15-ampere fuse.

(4) INSTRUMENT PANEL LAMPS. — Three dashlite lamps, using Mazda No. 303 bulbs and used for the illumination of the instrument panel, are installed one on each forward side of the pilots' compartment and one on the forward side of the control pedestal. The three dashlites are controlled by the Ohmite 352, Model H, 35-ohm, "PANEL LIGHTS" rheostat on the left-hand electrical panel. One AN5734-1 (grain-of-wheat) bulb is installed in the upper part of the compass. One 140-ohm resistor (AAF 37A5222-13) is installed on the back of the left-hand electrical panel for the compass lamp circuit; a spare grain-of-wheat bulb is mounted in the upper center section of the instrument panel, below the compass. The compass lamp is controlled by the Ohmite 352, model H, 175-ohm, "COMPASS LIGHT" rheostat on the left-hand electrical panel. All four of these lamps are in one circuit, wired to power through a 6-ampere circuit breaker (15-ampere fuse on some airplanes) in the main electrical junction box. Refer to paragraph 14.*d.*(4), this section, for removal and maintenance instructions.

(5) FLUORESCENT LAMPS.—The fluorescent lamps installation on all C-47A and early C-47B airplanes is similar to that described for the C-47 airplanes in paragraph 14.*d.*(5), this section, except that on some airplanes, the inverter switch on the right-hand electrical panel must be turned "ON" before the fluorescent lamps can be operated. On these airplanes, the fluorescent lamps switch is on the lower right-hand side of the instrument panel (13, figure 459), and is connected to the inverter (figure 493) through a 5-ampere fuse on the inverter relay panel. On late C-47B airplanes simply turn fluorescent switch (see figure 437) located just above the instrument panel on either side of pilots' compartment to "START."

(6) INTERAIRCRAFT SIGNAL LAMP. — On some airplanes, a Hubbel 7526 receptacle is provided on the aft wall of the pilots' compartment, in back of the copilot's seat, in which to plug the type C-3A, 24-V, interaircraft signal lamp, U.S. Army Specification No. 94-32288. The plug is grounded in the copilot's radio junction box and is wired to power in the compass junction box through a 15-ampere fuse in the liaison and command junction box. On other airplanes, the spare plug in the suit heat rheostats (in the pilots' compartment) is used for the interaircraft signal lamp.

(7) LANDING LAMPS. *(See figure 456.)*—The landing lamps installation is similar to that described for the C-47 airplanes in paragraph 14.*d.*(7) this section, except for the following changes: on C-47A and early C-47B airplanes the lamp assemblies use a Mazda G-25, 24-volt, 420-watt, Mogul prefocus base bulb; on late C-47B airplanes a PAR 64, 24-volt, 600-watt

seal-beam bulb is used; the landing lamp relays are Leach 5055; on some airplanes, each landing lamp switch is wired to power through a 5-ampere circuit breaker instead of a 20-ampere fuse; on some airplanes, each landing lamp relay is wired to power through a 35-ampere circuit breaker instead of a 50-ampere fuse.

(8) POSITION LAMPS. *(1 and 17, figure 455.)*—The position lamps installation is similar to that described for the C-47 airplanes in paragraph 14.*d.*(8), this section, with the following changes: the wing tip position lamps use AN3122-1524 bulbs; the AN3092-2 (former type D-2) tail cone position lamp uses an AN3121-313 bulb; on some airplanes, the switches are wired to power through a 6-ampere circuit breaker instead of the 15-ampere fuse.

(9) RECOGNITION LAMPS. *(9, 14, figure 455.)*—The recognition lamps installation is similar to that described for the C-47 airplanes in paragraph 14.*d.*(9), this section, with the following changes: the AN3096-4, -5, and -6 (formerly type E-2) downward recognition lamps use AN3120-1047 bulbs; the AN3097-2 (formerly type E-1) upward recognition lamp uses an AN3120-1047 bulb; on some airplanes, the upward recognition lamp is eliminated; on some airplanes, the circuit is wired to power through a 15-ampere circuit breaker instead of a 20-ampere fuse.

(10) PASSING LAMP. *(2, figure 456.)*—The passing lamp installation is similar to that described for the C-47 airplanes in paragraph 14.*d.*(10), this section, with the following changes: the passing lamp bulb used is a Mazda No. 310 natural ruby bulb; on some airplanes, the circuit is wired to power through a 6-ampere circuit breaker instead of a 15-ampere fuse. This lamp is deleted on later airplanes.

(11) FORMATION LAMPS.
(2 and 12, figure 455.)

(a) DESCRIPTION.—On some airplanes, nine type C-1 AN3030-5), formation lamps Army 94-32264 are installed, three on top of the center fuselage and three on top of each wing. Each lamp uses an AN3121-313 bulb. The lamps are operated in unison by the Ohmite Model J, type 352, 25-ohm, 50-watts "FORMATION LIGHTS" rheostat, on right-hand electrical panel. The circuit is wired to power through a 5-ampere circuit breaker in main electrical junction box.

(b) REMOVAL.

1. LAMP.—Remove the screws from the outer edge of the lamp, pull the lamp out from the skin far enough to disconnect the plug, and remove the lamp.

2. RHEOSTAT.—Same as described in paragraph 14.*b.*(3)*(d)2.*, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

(d) INSTALLATION.—Reverse procedure as described in paragraph *(b)*, removal, preceding.

(12) WARNING LAMPS.

(a) OIL-PRESSURE WARNING LAMPS.—On some airplanes only, an oil-pressure warning lamp system is installed, similar to that described for the C-47 airplanes in paragraph 14.*d.*(11), except that AN3121-313 bulbs are used.

(b) FUEL PRESSURE WARNING LAMPS.—On some airplanes only, a fuel pressure warning lamp system is installed, similar to that described for the C-47 airplanes in paragraph 14.*d.*(11), except that AN3121-313 bulbs are used.

(c) LANDING-GEAR WARNING SIGNAL LAMPS. *(12, 14, figure 459.)*—The landing-gear warning signal circuit is similar to that described for the C-47 airplane in paragraph 14.*d.*(11), with the following changes: the warning lamp assemblies use AN3121-313 bulbs: the warning lamps dimming resistors are of the Ohmite No. 1011, 75-ohm type; the antenna reel control box lamp relay is of the Leach 1013-24DE type; on some airplanes, the warning lamp and horn circuit is wired to power through a 15-ampere circuit breaker instead of the individual 15- and 20-ampere fuses.

(d) DOOR OPEN WARNING LAMP.—The cargo door warning lamp installation is similar to that described for the C-47 airplanes in paragraph 14.*d.*(11), this section, with the following changes: the warning lamp uses an AN3121-313 bulb; on some airplanes, the circuit is wired to power through a 6-ampere circuit breaker instead of a 15-ampere fuse.

(e) PARACHUTE TROOP WARNING LAMPS.—The paratroop warning lamp installation is similar to that described for the C-47 airplanes in paragraph 14.*d.*(11), this section, with the following changes: the lamps use AN3121-313 bulbs; on some airplanes, the circuit is wired to power through a 6-ampere circuit breaker instead of a 15-ampere fuse.

(f) PARACHUTE PACK RACK WARNING LAMP.—One Korry 103-A-RED warning lamp is installed on the parachute pack rack control box. Information on this lamp will be found in paragraph 14.*k.*(13) parachute pack rack lamps.

(g) HEATING AND VENTILATING WARNING LAMPS.

1. DESCRIPTION.—Four Avia 1505-1 heat and vent warning lamp assemblies are installed, two on the right-hand side of the instrument panel (11, figure 459), and two on the aft bulkhead of the radio operator's compartment (figure 543). Each lamp assembly contains two AN3121-313 bulbs. One Fenwall type 732-IF thermoswitch is installed in the heating and ventilating system air inlet line of each wing, on the outboard side of each nacelle. When the temperature of the air in the line rises to 232°C (450°F), the thermoswitch closes the warning lamp circuit, and the lamps for that wing system go "ON." The thermoswitch in the right wing operates the lamp marked "RIGHT" in both the pilots' and radio operator's compartments, and the thermoswitch in the left wing operates the lamps marked "LEFT." Thus, both the pilot and radio operator are warned when the spill valve control (in the radio operator's compartment) should be operated. Each thermoswitch is wired to power (at the power side of each landing lamp relay) through a 15-ampere fuse in the nacelle junction box.

2. REMOVAL.

a. LAMPS.—Bulbs may be removed by removing the lamp assembly cover. In order to remove the lamp assembly, it is necessary to pull forward the mount, disconnect attaching wire, and remove lamp attaching screws.

b. THERMOSWITCH.—Disconnect wires, remove attaching screws, and pull switch from duct.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

4. INSTALLATION.—Reverse procedure as described in paragraph *2.*, removal, preceding.

(b) OXYGEN PRESSURE WARNING LAMPS.

1. DESCRIPTION.—On some airplanes, four amber oxygen pressure warning lamps (AAF42B3593-2), using AN3121-313 bulbs, are installed, one above the pilot, one above the copilot, one in the navigator's compartment, and one in the radio operator's compartment, on the oxygen instrument panels. On other airplanes, only three oxygen pressure warning lamps are provided, the one in the radio operator's compartment being eliminated. Two type G-1 pressure signal assemblies (AAF94-32376), are installed, one in the oxygen system for the pilot and mounted behind the pilot's seat and one in the oxygen system for the other crew members, and mounted behind the copilot's seat. The pressure signal assembly consists of a switch, separated from the oxygen pressure by a diaphragm. The diaphragm forces the switch contacts closed, turning "ON" the warning lamps, when the oxygen pressure drops to 100 ± 10 psi. The circuit is wired to power through a 5-ampere circuit breaker in the main electrical junction box. Refer to section V, paragraph 2. for information on the oxygen system.

2. REMOVAL.

a. LAMPS.—Bulbs may be removed by unscrewing the lamp cover. In order to remove the lamp assembly, it is necessary to disconnect wires and remove attaching screw.

b. PRESSURE SIGNAL ASSEMBLY.

(1) Disconnect electrical plug.

(2) Disconnect oxygen line.

(3) Remove attaching studs on aft side of pilot's compartment bulkhead and remove assembly.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary, except for tightening any loose connections.

4. INSTALLATION.—Reverse procedure as described in paragraph *2,* removal, preceding.

(13) PARACHUTE PACK RACK LAMPS. *(See figure 608.)*—The parapack lamps are similar to those described for the C-47 airplane in paragraph 14.*d.*(12), this section, with the following changes: the lamps use AN3121-313 bulbs; on some airplanes, the parapack release fuse is replaced by a 20-ampere circuit breaker.

l. ICE ELIMINATION ELECTRICAL.

(1) GENERAL.—Only the electrical units in the ice elimination system are discussed in the following paragraphs. Refer to ice elimination system, paragraph 19., this section, for further information.

(2) PROPELLER ANTI-ICER PUMP MOTOR. *(See figure 574.)*—The Eclipse type 744-6 propeller anti-icer pump motor installation is similar to that described for the C-47 airplanes in paragraph 14.*e.*(2), this section, with the following changes: the speed of the motor is controlled by an Eclipse 567-1 rheostat; on some airplanes, the circuit is wired to power through the 10-ampere de-icer equipment circuit breaker instead of a 15-ampere fuse.

(3) SURFACES DE-ICER DISTRIBUTOR VALVE MOTOR. *(See figure 556.)*—The Eclipse type 572-2 surface de-icer rotary distributing valve motor installation is similar to that described for the C-47 airplanes in paragraph 14.*e.*(3), this section, with the following changes: the valve motor has been changed to the 24-volt type; a CA-275X condenser is wired to the de-icer valve motor to reduce interference to the radios; on some airplanes, the circuit is wired to power through the 10-ampere de-icer equipment circuit breaker instead of a 15-ampere fuse.

(4) WINDSHIELD ANTI-ICER SOLENOID PULSATING UNIT. *(See figure 574.)*—The windshield anti-icer pulsating unit installation is similar to that described for the C-47 airplanes in paragraph 14.*e.*(4), this section, with the following changes: a 24-volt acrotorque Model D-11781 or D-13382 solenoid is used on the pump which is mounted on the forward bulkhead of the right-hand baggage compartment; on some airplanes, the control switch is mounted on the left-hand electrical panel; the circuit is wired to power through a 6-ampere circuit breaker instead of a 15-ampere fuse.

(5) CARBURETOR ANTI-ICER PUMP MOTOR. *(See figure 563.)*—The carburetor anti-icer pump motor installation is similar to that described for the C-47 airplanes in paragraph 14.*e.*(5), this section, with the following changes: an Adel D-7818, Series J-4.0—24-v—D4 motor-driven pump is used; on some airplanes, the circuit is wired to power through a 6-ampere circuit breaker instead of a 15-ampere fuse.

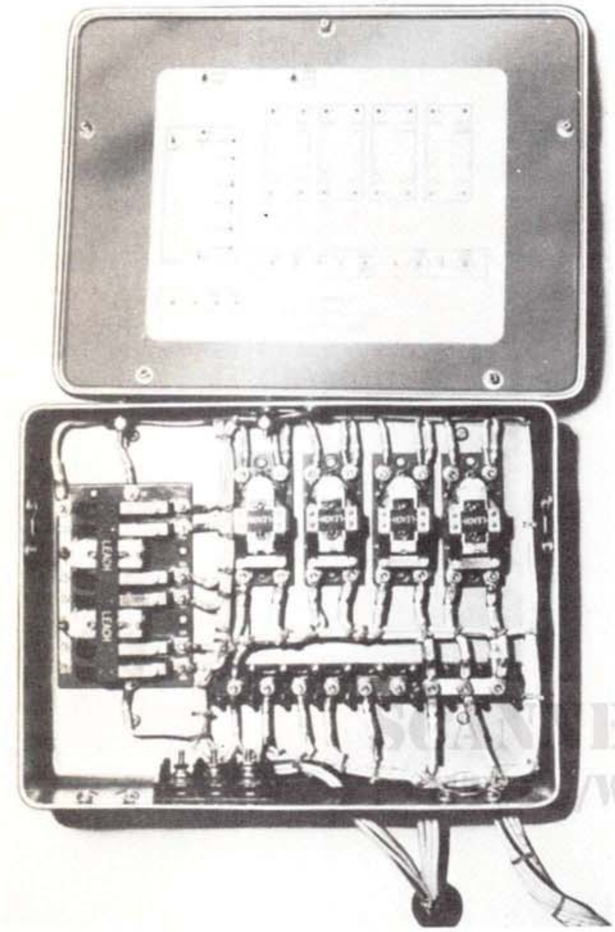


Figure 470—Center Parapack Junction Box

(6) WINDSHIELD DEFROSTER MOTOR.
(See figure 543.)

(a) DESCRIPTION. – On some airplanes, an English and Lauer CM-025-4½CC, ¼-horsepower windshield defroster blower motor is installed in the navigator's compartment, above the dome lamp. The blower motor is controlled by a type B-6B, AN3016 spring-loaded switch, mounted on the heating and ventilating defrost valve, in the aft section of the navigator's compartment (figure 545). The switch is operated by a pin attached to the defrost valve control. When the control is placed in the "EMERGENCY DEFROST" position, the switch is turned "ON"; when the control valve position is changed, the switch springs back to its normally "OFF" position. A CA-275X condenser is included in the blower motor circuit to reduce interference to the radios.

(b) REMOVAL.—Disconnect electric wires, remove attaching screws, and remove motor.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replace motor brushes if worn to within 1/16 inch of the brush holders. No lubrication or other maintenance is necessary until major overhaul periods (approximately 60 hours of operation).

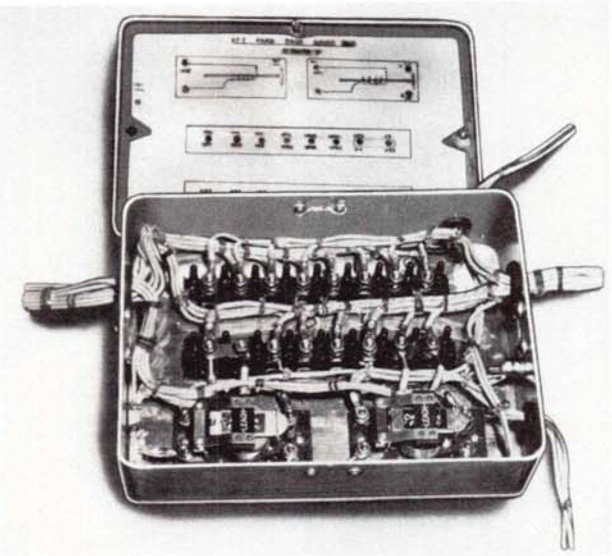


Figure 471—Aft Parapack Junction Box

(d) INSTALLATION. – Reverse procedure as described in paragraph *(b)*, removal, preceding.

m. PARACHUTE PACK RELEASE ELECTRICAL. —The electrical parachute pack release provisions are similar to those described for the C-47 airplanes in paragraph 14.*f.*, this section with the following changes: type A-2 (R.H.) bomb release mechanisms AAF24699-A are used for parapack release; the parapack release relay is a Leach 1220-DE type; the parapack salvo relay is a Leach 2036-LB (24-volt) type; on some airplanes, the parapack salvo circuit is wired to power through a 15-ampere circuit breaker and the parapack release and control circuit is wired to power through a 20-ampere circuit breaker instead of the 15-ampere fuse and the 35-ampere fuse, respectively.

■ *ma.* MOTOR, AIR INDUCTION SYSTEM.—A Barber-Colman No. ALYC5091 motor is incorporated in 300 early C-47B airplanes to operate a ram non ram filtered design of the air induction system. This electric motor is installed on the underside of the accessory cowling of the engine and is supported by a clamping type bracket. The motor activates a rod linkage which, through a cam and cable system, operates the two doors of the air induction mechanism. The motor incorporates two limit switches, one of which is adjustable. These switches are located inside the motor. The motor is controlled by two five position selector switches located on the left hand side of the pilots' compartment under the side windshields and forward near the instrument panel. The pointer of the selector switch must be turned in a clockwise motion; counterclockwise motion will not operate the motor. See description of Air Induction System, paragraph 6.*c.*(1)*(e)*.

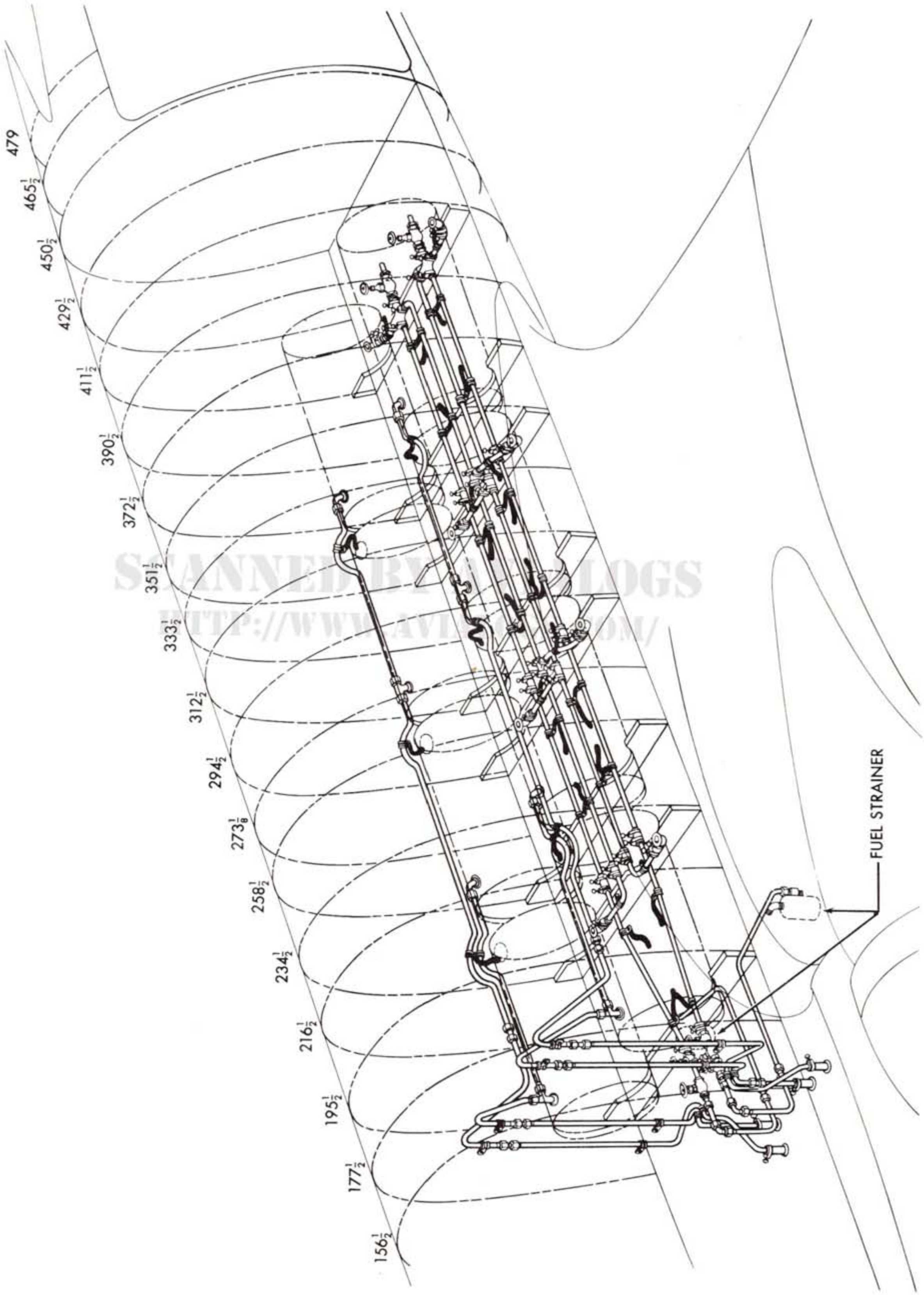

479
465½
450½
429½
411½
390½
372½
351½
333½
312½
294½
273⅛
258½
234½
216½
195½
177½
156½
FUEL STRAINER

Figure 471A—Bonding Layout—Ferry Fuel System

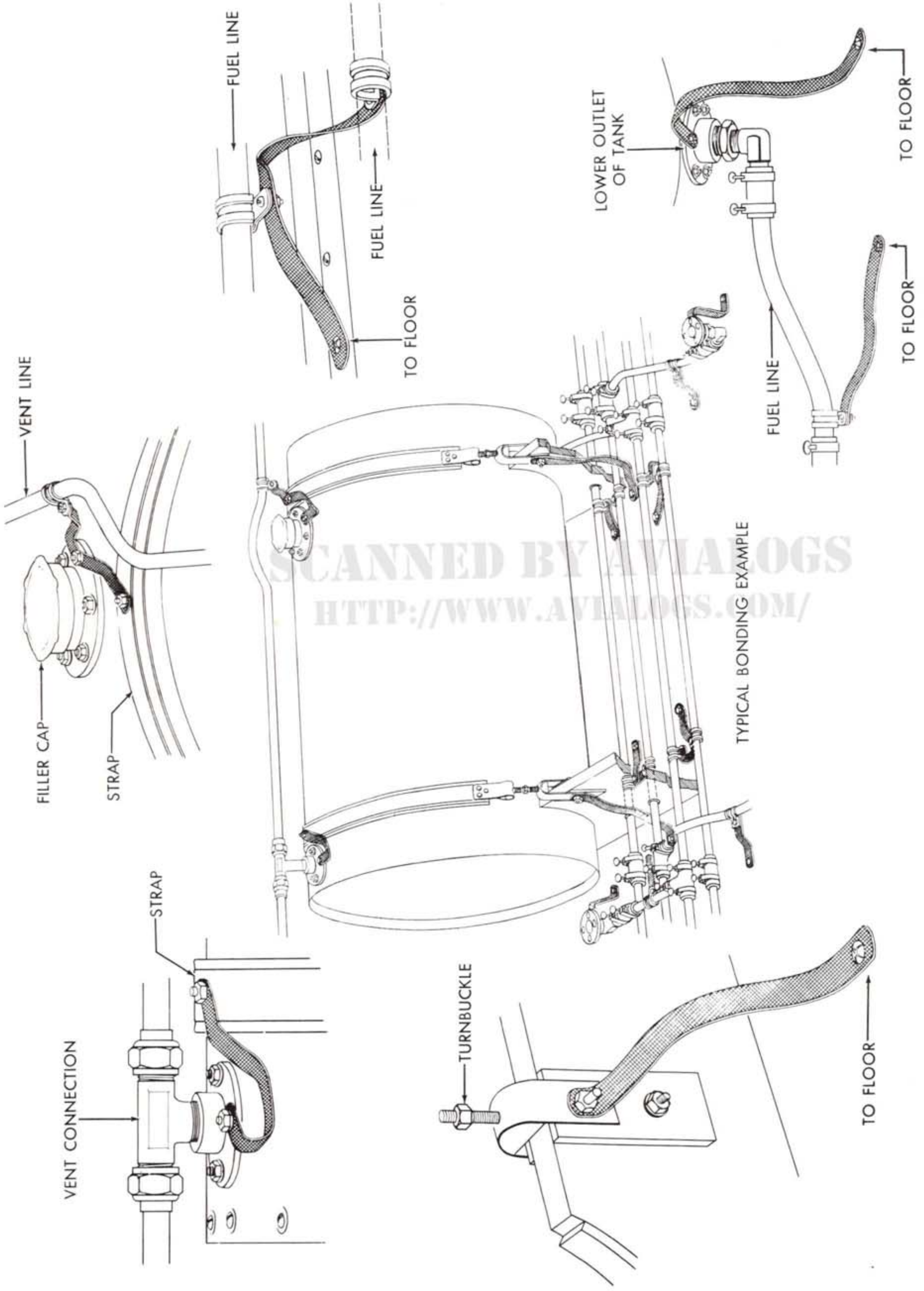

VENT LINE
FILLER CAP
STRAP
FUEL LINE
FUEL LINE
TO FLOOR
LOWER OUTLET OF TANK
TO FLOOR
TO FLOOR
FUEL LINE
TYPICAL BONDING EXAMPLE
VENT CONNECTION
STRAP
TURNBUCKLE
TO FLOOR

Figure 471B—Typical Examples of Bonding

n. MISCELLANEOUS EQUIPMENT.

(1) BAIL-OUT ALARM BELL. – The alarm bell installation is similar to that described for the C-47 airplanes in paragraph 14.*g.*(1), this section, with the following changes: On some airplanes, a second alarm bell is mounted above the aft main cargo dome lamp; AAF 50291 (24-volt dc) alarm bells are used; the alarm bell circuit is directly connected to power at the battery disconnect relay.

(2) SUIT HEAT RHEOSTATS. *(9, figure 497.)*

(a) DESCRIPTION. – On some airplanes, five type Q-1A suit heat rheostats, U.S. Army Specification No. 94-32357, are installed, one beside each crew member's seat and one in the forward passageway for the crew chief. The rheostat is used to regulate the temperature in a heated flying suit by controlling the current. This rheostat consists of a coil of resistance wire, tapped at intervals, and arranged so that manipulation of the handle varies the resistance in the circuit. Two twist lock type receptacles are provided for connecting the flying suit or miscellaneous electrical equipment to the rheostat. The pilots' and navigator's rheostats are wired to power through a 35-ampere circuit breaker, the copilot's and radio operator's rheostats are wired to power through a 35-ampere circuit breaker, the crew chief's rheostat is wired to power through a 20-ampere circuit breaker, all in the main electrical junction box.

(b) REMOVAL.—Disconnect the electrical wire, remove attaching screws, and remove the rheostat.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Replacement, rather than repair, will be necessary.

(d) INSTALLATION. – Reverse procedure as described in paragraph *(b)*, removal, preceding.

na. ELECTRICAL BONDING.

(1) GENERAL.—This airplane is bonded in accordance with Specification AN-B-10 and Douglas Drawing No. 5202128.

(2) PURPOSE.—Bonding is for the purpose of attaining the following results:

(a) To protect the airplane and personnel from lightning discharges by equalization of potentials produced which might cause arcs and sparks on the airplane structure.

(b) To provide a homogeneous counterpoise in lieu of the ground connection for radio transmission and reception.

(c) To improve conductivity between surfaces which act as shields for reducing radio noise impulses.

(d) To break up natural periods of structural members which may be exposed to violent impulses likely to set up electrical oscillations.

(3) FERRY FUEL SYSTEM.—It is important that the bonding of the ferry fuel system be understood. This is necessary because of the apparent need for removal and installation of the ferry fuel system in the field. (See figures 471A and 471B.)

o. ELECTRICAL SYSTEM TROUBLE SHOOTING.

(1) GENERAL.—If an electrical device malfunctions, there are two general possibilities—the device itself may be at fault (burned out, damaged mechanically, etc.) or that part of the circuit leading to or from the device may be at fault. Continuity testing refers to checking for the existence of a complete electrical system between two points. The three main types of continuity testers are:

(a) The portable dry cell tester, having a buzzer or a 3-volt lamp to indicate the completed circuit, is used to test circuits with the main circuit power off.

(b) An ordinary lamp bulb (12- or 24-volt, according to airplane electrical system) with one lead from the center lamp contact and one ground lead attached to the lamp housing, can be used to test circuits with the main circuit power on.

(c) A precision voltmeter is used to test circuits with the main circuit power on, by putting positive lead on circuit point and negative lead on any convenient ground.

(2) The circuit should be tested at each terminal of the circuit. Between the last point at which voltage is indicated (or lamp goes on) and the first point at which zero voltage is indicated (lamp does not go on), there is an open circuit or a voltage drop caused by unit operation or short to ground. If the same voltage reading is obtained on the negative terminal of a unit as was obtained on the positive terminal, an open ground is indicated. If a small voltage reading is obtained on the negative terminal of the unit, a high resistance is indicated between the unit and ground.

(3) GENERATOR SYSTEM TROUBLE SHOOTING.

Trouble	*Test Procedure*	*Final Check and Remedy*
GENERATOR FAILS TO BUILD UP ABOVE ABOUT 2 VOLTS. THIS INDICATES THE TROUBLE IS CAUSED BY ONE OF THE FOLLOWING:		
VOLTAGE REGULATOR OR BASE.	Take precision voltmeter reading between "A" terminal of voltage regulator and ground.	

Trouble	*Test Procedure*	*Final Check and Remedy*
VOLTAGE REGULATOR OR BASE—Continued.	No voltage reading indicates trouble in either regulator or base. Reading of about 2 volts indicates regulator and base are OK.	Remove regulator from base and check base contact fingers by pressing on them. If they are broken, replace base. Check G.E. regulator contact reeds where they rest on the silver contact bus bar. Any signs of burning at this point is cause for replacement of regulator.
RESISTANCE IN GENERATOR FIELD CIRCUIT.	Remove voltage regulator from base. Take ohmmeter reading (or use continuity light) between "A" contact finger of regulator base and ground.	
	High ohmmeter reading (or dim light) indicates resistance in field circuit which prevents normal field build-up.	Check for corrosion, oil, or dirt at generator connector plug.
OPEN GENERATOR FIELD CIRCUIT.	Infinite ohmmeter reading (or no light) indicates open circuit. Probably the "A" lead is broken at the connection plug where it solders on.	Replace voltage regulator in base and disconnect generator plug. Place one lead of ohmmeter (or continuity light) in "A" hole and other lead in "B" hole of connector plug. If this check gives low ohmmeter reading (or light goes on), circuit is good and "A" lead is at fault. Correct defective lead.
DEFECTIVE GENERATOR.	Low ohmmeter reading (or bright light) indicates current is good and trouble must be within generator.	Disconnect generator plug. Place one lead of ohmmeter (or continuity light) on "A" terminal and the other lead on "E" terminal. High ohmmeter reading (no light) indicates that the generator field is open. Replace generator.
LOW GENERATOR OUTPUT. INSTRUMENT PANEL VOLTMETER READING OF FROM 10 TO 20 VOLTS. THIS INDICATES INCORRECT VOLTAGE REGULATOR ADJUSTMENT OR FAULTY GENERATOR CAUSED BY: SHORTED FIELD. SHORTED ARMATURE. GROUND CONNECTION WITHIN GENERATOR.	Adjust voltage regulator as described in paragraph 14., preceding and check system. If no increase in generator output is found, check generator.	Run engine to 1800 rpm. Put one end of short length of wire No. 18 or larger on "A" terminal and other end on "B" terminal of voltage regulator. If instrument panel voltmeter does not read excessive voltage, generator is not capable of producing normal voltage. Replace generator.
INSTRUMENT PANEL VOLTMETER READING OF EXCESSIVE VOLTAGE. THIS IS DUE TO ONE OF THE FOLLOWING: SHORT ACROSS "A" AND "B" TERMINAL.		
LACK OF VOLTAGE REGULATOR CONTROL. (OPEN CIRCUIT IN CONTROL COIL OF REGULATOR.)	Check to see if trouble is due to broken "G" contact finger on mounting base.	Excessive output due to either cause will, in most cases, result in a burnt up generator. Replace generator.

Trouble	*Test Procedure*	*Final Check and Remedy*
INSTRUMENT PANEL VOLTMETER READING OF ZERO VOLTS. THIS IS DUE TO ONE OF THE FOLLOWING:		
DEFECTIVE VOLTMETER CIRCUIT.	Run engines at 1800 rpm. Take precision voltmeter reading between "B" terminal of regulator and ground.	
	Reading of 28 volts indicates generator and circuit are good and instrument panel voltmeter circuit is defective.	Place positive lead of precision voltmeter on positive terminal of instrument panel voltmeter and negative lead to ground. Reading should be 28 volts. If not, lead from regulator to instrument panel voltmeter is defective. Replace or correct lead. Place positive lead of precision voltmeter on negative terminal of instrument panel voltmeter and negative lead to ground. If voltmeter reading is zero, instrument panel voltmeter is defective. Replace voltmeter. If both voltmeters read on this check, the ground lead from the instrument panel voltmeter is defective. Replace or correct lead.
	Reading of 2 volt indicates residual magnetism.	Proceed with test procedure for 2-volt voltmeter reading as stated at beginning of paragraph 14.*o*.(3).
	Reading of 0 volts indicates trouble is not in voltmeter circuit.	
BROKEN "B" OR "E" LEAD.	Remove voltage regulator and take ohmmeter reading (or continuity light) between "B" contact finger of regulator base and ground.	
	Low ohmmeter reading (or light on) indicates that circuit is ok. High ohmmeter reading (or dim light) indicates that a high resistance is the trouble.	High resistance most likely caused by oil, dirt, or burning at connector plug or commutator. Sand commutator with No. 000 sandpaper and wash with unleaded gasoline. Dry thoroughly and blow out dust.
	Very high ohmmeter reading (no light) indicates open circuit.	Check lead from regulator to relay. Check lead from relay to generator. Check generator ground lead.
LOSS OF RESIDUAL MAGNETISM.	Flash the generator field by removing voltage regulator and momentarily touching a wire, connected to a battery source, to the "A" terminal of the regulator base.	Turn engines off and start them up again. Voltage should come up normally. If not, check generator commutator and connector plug for burning, dirt, and oil.

CAUTION. Never flash the generator field by manually closing the reverse-current relay contacts.

Trouble	*Test Procedure*	*Final Check and Remedy*
DEFECTIVE GENERATOR. IF VOLTAGE DOES NOT BUILD UP PROPERLY WHEN FIELD IS FLASHED, DISCONNECT GENERATOR CONNECTOR PLUG AND CHECK FOR THE FOLLOWING:		
OPEN FIELD.	Take ohmmeter reading (or continuity light) between "A" and "E" terminals of generator connector plug. High ohmmeter reading (no light) indicates field circuit is open.	Check and repair lead or connections.
GROUNDED FIELD.	Take ohmmeter reading (or continuity light) between "A" terminal of generator and generator housing. Low ohmmeter reading (light on) indicates field is grounded.	Insulation on field winding is broken. Replace generator.
OPEN ARMATURE.	Remove generator cover and inspect commutator. If solder is melted and has been thrown off, then armature is open (caused by generator overheating).	Replace generator.

SUMMARY

Most generator troubles are the result of carelessness in adjustment and inspection. Look for bad brushes, burnt commutators (the result of weak spring tension), defective connector plugs, frayed cables, oil in generator, and broken flanges. Be sure that paralleling adjustment is made correctly (see text on voltage regulator adjustments preceding). Be sure to make final check of system voltage by taking voltmeter reading at any point of the bus bar system. This reading must be between 28 and 28.5 volts.

(4) BATTERY SYSTEM TROUBLE SHOOTING.

Trouble	*Probable Cause*	*Remedy*
BATTERY WILL NOT HOLD ITS CHARGE.	Battery is worn out.	Remove and send to service depot for capacity test.
	Charging rate not set right.	Check and correct the setting of the voltage regulator as described in paragraph 14.*b.*(2)*(c)4.*, (C-47) or paragraph 14.*i.*(2)*(d)4.*, (C-47A) this section.
	Discharge too great to replace.	Use of starter, etc., on the ground and other electrical equipment in air must be reduced. (Use external power source whenever possible for starting.)

Trouble	*Probable Cause*	*Remedy*
BATTERY WILL NOT HOLD ITS CHARGE—Continued.	Standing too long (hot climate).	Battery will require removal and recharge if left in an unused airplane for one week or more, depending upon the temperature. For example, a fully charged battery will lose approximately ½ its charge in the following number of days for the temperatures given: 15.6°C (60°F)—90 days 26.7°C (80°F)—45 days 37.8°C (100°F)—14 days 49°C (120°F)— 6 days
	Equipment left on accidentally.	Remove and recharge battery.
	Short circuit, or ground, in wiring.	Check wiring and correct trouble.
	Broken cell partition.	This is usually indicated by two or more adjacent cells running down continually, particularly if left standing a few days. Replace battery.
BATTERY LIFE IS SHORT.	Overcharge.	This causes buckling of plates, shedding of active plate material, oxidation of grids, overheating, excessive loss of water and excessive gassing. Check and correct adjustment of voltage regulator as described in paragraph 14.*b*.(2)*(c)4.*, (C-47), or paragraph 14.*i*.(2)*(d)4.*, (C-47A), this section.
	Level of electrolyte below top of plates.	Keep electrolyte level ⅜ inch above the protector plate.
	Frequent discharges.	This is due to excessive use of starter and then recharging in the air which uses the battery excessively. Use external power sources wherever possible to conserve the battery.
	Sulphated plates.	This occurs when the battery is left in a discharged or undercharged (½ or less) condition for a period of time, or electrolyte is not maintained at its proper level. Return to service depot for tests and overhaul.
	Improper storage.	Dry batteries stored in a damp location, or wet batteries stored for too long a period without charging, allow the plates to sulphate. Return to service depot for overhaul.
CRACKED CELL JARS.	Hold-down loose.	Replace the battery and tighten hold-down clamps.

Trouble	*Probable Cause*	*Remedy*
CRACKED CELL JARS – Continued.	Frozen battery.	This is caused by one of the following: *(1)* Adding water in cold weather without charging the battery sufficiently afterward to thoroughly mix the water with the electrolyte before allowing it to stand. *(2)* Allowing the battery to become discharged which permits it to freeze on account of its low specific gravity under these conditions. *(3)* Low specific gravity of the electrolyte caused by improper filling. Replace battery with fully charged one.
COMPOUND ON TOP OF BATTERY MELTS.	Charging rate too high.	Check and correct setting of voltage regulator as described in paragraph 14.*b*.(2)*(c)*4., (C-47), or paragraph 14. *i*.(2)*(d)*4., (C-47A), this section.
	Electrolyte on top of cells.	Electrolyte on top of the cells caused by overfilling or improper operation of the ventilating system may short circuit the battery. The resulting heat will then soften the battery compound. To correct this condition, be sure the ventilating lines are clear, remove any electrolyte from the top of the battery and neutralize with sodium bicarbonate. Then wash the top of the battery thoroughly, charge and reinstall in the airplane.
ELECTROLYTE RUNS OUT OF VENT CAPS.	Too much water added to battery.	Remove excess with self-leveling syringe.
	Excessive charging rate.	Check regulating equipment involved.
EXCESSIVE CORROSION INSIDE CONTAINER.	Overcharging.	Check and correct setting of voltage regulator as described in paragraph 14.*b*(2)*(c)*4., (C-47), or paragraph 14. *i*.(2)*(d)*4., (C-47A), this section.
	Spillage.	Spillage is usually caused by overfilling, although in rare cases may be caused by cracked or melted sealing compound. Remove excessive electrolyte. Reseal if necessary.
	High charging rate.	Correct setting of regulating equipment involved.
	Vent lines leaking or clogged.	Clean out vent lines and replace any leaky hose.
	Improper venting.	Output hose not connected at lowest vent of battery. Relocate hose to drain from lowest vent in taxying position.

Trouble	*Probable Cause*	*Remedy*
BATTERY FREEZES.	Discharged battery. (See table below.)	Replace with fully charged battery.
	Water added and battery not charged immediately.	This is an important point. WATER SHOULD NEVER BE ADDED IN FREEZING WEATHER WHEN BATTERIES ARE TO BE LEFT STANDING BEFORE CHARGING. About a half-hour charge will mix the water with the electrolyte. The freezing point will then be in accordance with the table given below.
	Leaking jar.	Water added and froze. Replace battery.
	Extreme cold. (See table below.)	In these cases it is almost always necessary to replace the battery, although in case of a partial freezing, thawing in a warm room may save it. It should be thoroughly checked before being used in an airplane. *Freezing Point* *Specific Gravity* — *Freezing Point* 1.300 — −71.0°C (−95°F) 1.275 — −62.0°C (−80°F) 1.250 — −52.0°C (−62°F) 1.225 — −37.2°C (−35°F) 1.200 — −26.6°C (−16°F) 1.175 — −20.0°C (− 4°F) 1.150 — +15.0°C (+ 5°F) 1.125 — +10.6°C (+13°F) 1.100 — + 7.2°C (+19°F)
BATTERY POLARITY REVERSED.	Battery connections reversed at charger.	Such a battery should be slowly discharged completely and then charged correctly.
	Battery connections reversed at airplane.	Such a battery should be slowly discharged completely and then charged correctly.
BATTERY CONSUMES EXCESSIVE WATER	Charging rate too high.	Check and correct setting of voltage regulator as described in paragraph 14.*b.*(2)*(c)4.*, (C-47), or paragraph 14.*i.*(2)*(d)4.*, (C-47A), this section.
	Electrolyte runs out of vent caps.	Level of electrolyte too high. Adjust level to ⅜-inch above protector plate.
BATTERY WILL NOT COME UP ON CHARGE	Battery worn out.	Replace with fully charged battery; send worn-out battery to service depot for testing.
	Battery badly sulphated.	Caused by standing idle in discharged condition. Return to service depot for tests and overhaul.

LAMPS LIST (C-47—12-VOLT)

Lamp	*Type*	*No. Req. Per Apl*	*Bulb*
Cockpit	Griff-Ho Dashlite	3	Mazda No. 67*
Dome	Gem City HD-1001	9	AN 3124-1141*
Door Open Warning	Korry 103-S	1	AN 3121-1816*
Extension	C-4 (Army 94-32294) 12v	1	AN 3121-1816*
or	C-7 (Army 94-32396)		
Fuel Pressure Warning	Korry 103-S	2	AN 3121-1816*
Instrument	(Furn with instrument)	4	AN 5734-2*
Instrument Board	Griff-Ho Dashlite	3	Mazda No. 67*
Interaircraft Signal	C-3A (Army 94-32388) 12v	1	13-volts, 6.6-amps PAR 46, screw terminal base
Landing	Dietz DO-WSX-LH & -RH	2	Mazda G-25, 12-volts, 420-watts, Mogul prefocus
	AC 44A18454-2	1	AN 3121-1816* (2 per assem)
Landing-Gear Warning	AC 44A18454-3	1	AN 3121-1816* (2 per assem)
Main Junction Box	Cannon SCF-D-O	1	AN 3124-1141*
Navigator's Work Table	A-11 (AF 32372)	1	Mazda No. 1142*
Oil-Pressure Warning	Korry 103-S	2	AN 3121-1816*
Parapack Release Indicator	Korry 103-S	6	AN 3121-1816*
Parapack Warning	Korry 103-S	1	AN 3121-1816*
Paratroop Warning	Korry 103-S	2	AN 3121-1816*
Passing	H. A. Douglas No. 1116 socket	1	Mazda No. 1144*
Position (Running)—Wing Tip	Grimes, Model E, No. A-1285-LH	1	AN 3122-1512*
	-RH	1	AN 3122-1512*
—Tail Cone	D-2 (Army 94-32266) (or Grimes, Type C with Mazda No. 94 bulb)	1	AN 3121-1816*
Recognition—Downward	E-2 (Army 94-32374)	3	AN 3120-1039*
Upward	E-1 (Army 94-32366)	1	AN 3120-1039
Voltammeter	H. A. Douglas No. 2948	1	Mazda No. 67*

*Explanation of bulb types:

AN 3120-1039—13 volts, 6.6-amps, RP-11, s.c., bay. base

AN 3121-1816—13-volts, .33-amps, T-3¼, bay. base

AN 3122-1512—12-16-volts, 21 c.p., GG-10, s.c. bay. indexing base (spl)

AN 3124-1141—12-16-volts, 21 c.p., S-8, s.c. bay. base

AN 5734-2—3-volts, .19-amp, T-1¼, Killsman base

Mazda No. 67—12-16 volts, 3 c.p., G-6, s.c. bay. base

Mazda No. 1142—12-16-volts, 21 c.p., S-8, d.c. bay. base

Mazda No. 1144—12-16-volts, 32 c.p., RP-11, d.c. bay. base

LAMPS LIST (C-47A—24-VOLT)

Lamp	*Type*	*No. Req. Per Apl*	*Bulb*
Ammeter	H. A. Douglas No. 2948	1	AN 3121-313*
Cockpit	Griff-Ho Dashlite	3	AN 3121-313*
Compass	(Furn with compass)	1	AN 5734-2*
Dome	Gem City HD-1001	9	AN 3124-307*
Door Open Warning	Korry 103S	1	AN 3121-313*
Extension	C-4 (Army 94-32294) 24v	1	AN 3121-313*
Fluorescent	AN 3038 (Former type C-5)	4	AN 3125-1*
Formation	AN3030-5 (Former type C-1)	9	AN 3121-313*
Fuel Pressure Warning	Korry 103-S	2	AN 3121-313*
Heat and Vent Warning	AC44A18454-2	4	AN 3121-313*
Instrument Board	Griff-Ho Dashlite	3	AN 3121-313*
Interaircraft Signal	C-3A (Army 94-32288) 24v	1	26-volts, 5.3-amps Par 46 screw terminal base
Landing (Early Airplanes)	Dietz DO-WSX-LH & -RH	2	Mazda G-25, 24-volts, 420-watts, Mogul prefocus
(Late Airplanes)	PAR 64 Seal Beam	2	Par 64, 24-volts, 600-watt
Landing-Gear Warning	AC 44A1845-2	1	AN 3121-313* (2 req per assem)
	AC 44A18454-3	1	AN 3121-313* (2 req per assem)
Main Junction Box	Cannon SCF-D-O	1	AN 3124-307*
Navigator's work Table	A-11 (AF 32372)	1	Mazda No. 308*
Oil-Pressure Warning	Korry 103-S	2	AN 3121-313*
Oxygen Pressure Warning	AF42B3593-2	3 or 4	AN 3121-313*
Parapack Release Indicator	Korry 103-S	6	AN 3121-313*
Parapack Warning	Korry 103-S	1	AN 3121-313*
Paratroop Warning	Korry 103-S	2	AN 3121-313*
Passing	H. A. Douglas No. 1116 socket	1	AN 3121-313*
Position—Wing Tip	Grimes, Model E No. 1285—LH	1	AN 3122-1524*
	—RH	1	AN 3122-1524*
—Tail Cone	AN 3092 (Former Type D-2)	1	AN 3121-313*
Recognition—Downward	AN 3096-4	1	AN 3120-1047*
	AN 3096-5	1	AN 3120-1047*
	AN3096-6 (former type E-2)	1	AN 3120-1047*
Upward	AN 3097-2 (former type E-1)	1	AN 3120-1047*

*Explanation of bulb types:

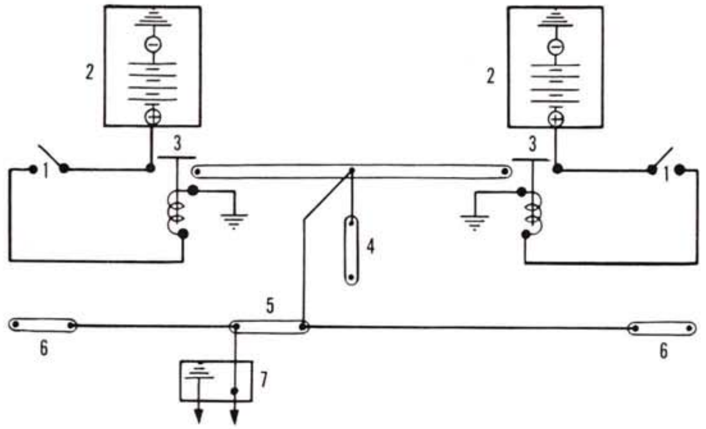
AN 3125-1—28-volts, .7-amps, s.c. bay. base
AN 3120-1047—26-volts, 2.7-amps, RP-11, s.c. bay. base
AN 3121-313—28-volts, .17-amps, T-3¼, min bay. base
AN 3122-1524—24-28-volts, 21 c.p., GG-10, s.c. bay. indexing base (Spl)
AN 3124-307—28-volts, 21 c.p., S-8, s.c. bay. base
AN 5734-2—3-volts, .19-amps, T-1¼, Kollsman base
Mazda No. 308—28-volts, 21 c.p., S-8, d.c. bay. base
Mazda No. 310—28-volts, 32 c.p., S-11, d.c. bay. base

Index to Figure 472—Wiring Diagrams (13 Sheets)

	Sheet
Battery Circuit (C-47)	1
Battery Circuit (C-47A)	1
Blower Warning Circuit	8B
Carburetor Anti-Icer Circuit	11
Dome Lamps Circuit (Original)	6
Dome Lamps Circuit (Revised)	7
Door Open Warning Lamp Circuit	10
Engine Temperature Gage Circuit	5
Fluorescent Lamps Circuit	8A
Formation Lamps Circuit	9
Fuel Booster Pump Circuit (Late C-47A and all C-47B)	4
Fuel Quantity Gage Circuit	5
Generator Circuit (C-47)	1
Generator Circuit (C-47A)	2
Generator Circuit (C-47B)	8B
Heat and Ventilating Warning Lamps Circuit	10
Ignition Circuit (C-47)	2
Ignition Circuit (C-47A)	2
Interaircraft and Extension Lamps Circuit	9
Landing-Gear Warning Lamps Circuit	8
Landing-Gear Warning Lamps Circuit (Late C-47B)	8A
Landing Lamps Circuit	9
Main Junction Box Lamp Circuit	9
Oil Dilution Circuit (C-47)	4
Oil Dilution and Engine Primer Circuit (C-47A)	4
Oil (or Fuel) Pressure Warning Lamps Circuit	10
Oxygen Pressure Warning Lamps Circuit	10
Parapack Circuit	12
Paratroop Warning Lamps Circuit	11
Passing Lamp Circuit	8
Pilots' Compartment Lamps Circuit (C-47)	6
Pilots' Compartment Lamps Circuit (C-47A)	6
Pitot Tube Heater Circuit	8

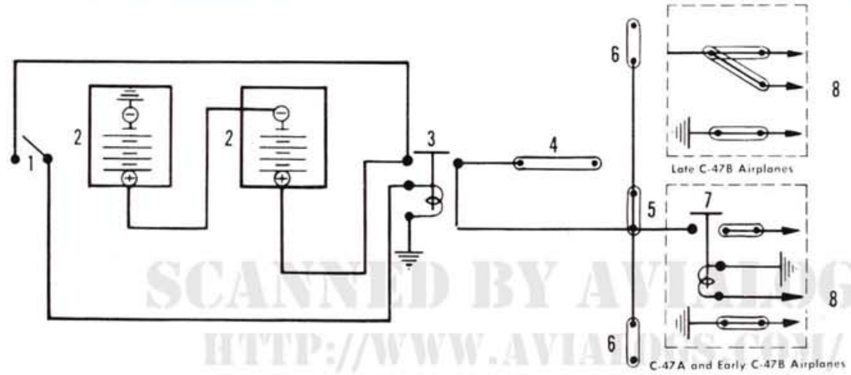
Index to Figure 472—Wiring Diagrams (13 Sheets)—Continued

	Sheet
Position (Running) Lamps Circuit	8
Propeller Feathering Circuit	3
Recognition Lamps Circuit	8
Remote Indicating Compass Circuit	5
Starter Circuit (C-47)	3
Starter Circuit (C-47A)	3
Suit Heat Rheostats Circuit	13
Surfaces and Propeller De-Icer Motors Circuit	11
Tachometer Circuit (Single Indicators)	4
Tachometer Circuit (Dual Indicator)	4
Temperature Instruments Circuit	4
Utility Outlet Circuit	13
Warning Bell Circuit	13
Windshield Defroster Blower Circuit	11
Windshield Anti-Icer Pump Circuit	11


2
2
3
3
1
1
4
5
6
6
7

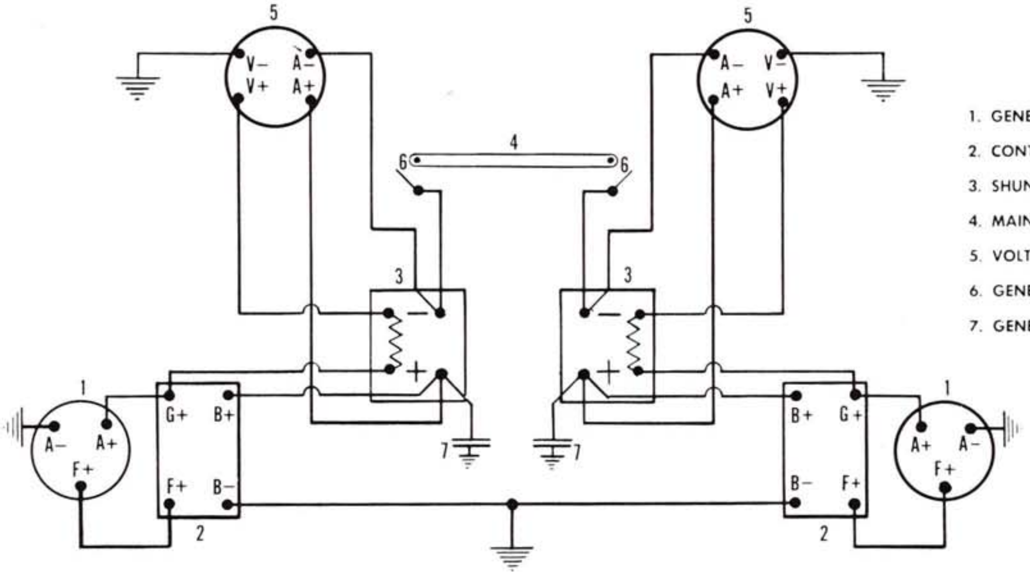
1. BATTERY SWITCH
2. BATTERY
3. BATTERY CONNECTOR RELAY
4. MAIN JUNCTION BOX FUSE BUS
5. TUNNEL BUS
6. FIREWALL JUNCTION BOX BUS
7. BATTERY CART RECEPTACLE

C-47 BATTERY CIRCUIT


1
2
2
3
4
6
8
Late C-47B Airplanes
5
7
8
6
C-47A and Early C-47B Airplanes

1. BATTERY SWITCH
2. BATTERY
3. BATTERY CONNECTOR RELAY
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. TUNNEL BUS
6. FIREWALL JUNCTION BOX BUS
7. ANTI-FLASHBACK RELAY
8. BATTERY CART RECEPTACLE JUNCTION BOX

C-47A BATTERY CIRCUIT

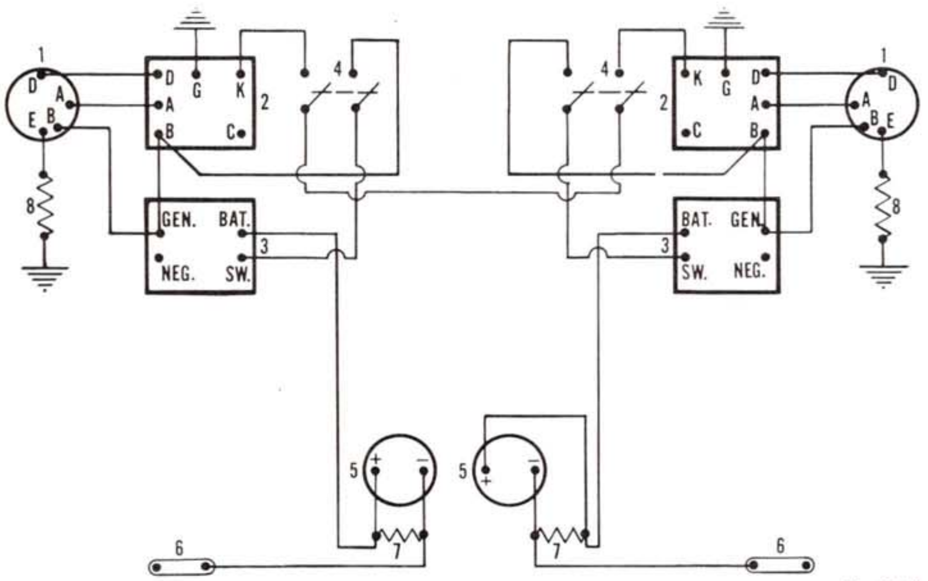

5
V−
A−
V+
A+
5
A−
V−
A+
V+
4
6
6
3
3
1
A−
A+
F+
G+
B+
F+
B−
7
7
B+
G+
B−
F+
1
A+
A−
F+
2
2

1. GENERATOR
2. CONTROL PANEL
3. SHUNT & RESISTOR UNIT
4. MAIN JUNCTION BOX FUSE BUS
5. VOLTAMMETER
6. GENERATOR MAIN LINE SWITCH
7. GENERATOR CONDENSER

C-47 GENERATOR CIRCUIT

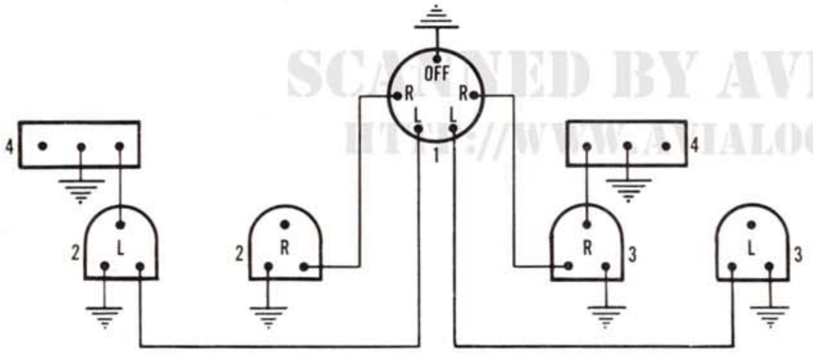
14,486

Figure 472—Wiring Diagram
(Sheet 1 of 13 Sheets)


1
D
A
E
B
G
K
C
2
GEN.
BAT.
NEG.
SW.
3
4
8
5
+
−
6
7

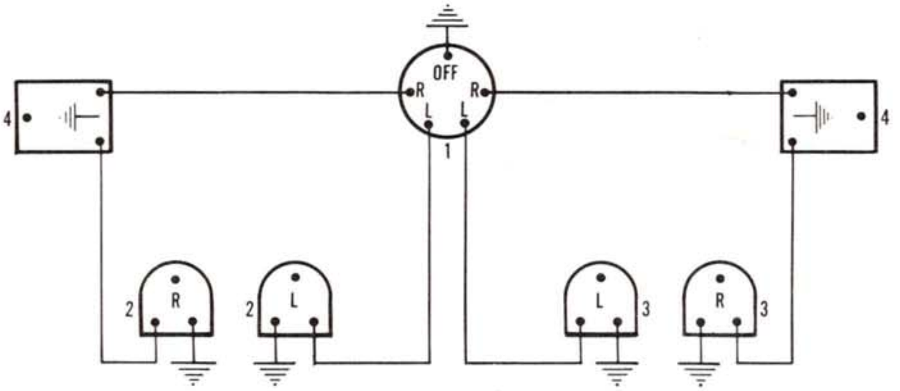
1. GENERATOR
2. VOLTAGE REGULATOR
3. REVERSE CURRENT RELAY
4. GENERATOR SWITCH
5. AMMETER
6. FIREWALL JUNCTION BOX BUS
7. AMMETER SHUNT
8. RESISTOR

C-47A GENERATOR CIRCUIT


OFF
R
L
1
4
2
3
L
R

1. IGNITION SWITCH
2. LEFT ENGINE MAGNETO
3. RIGHT ENGINE MAGNETO
4. BOOSTER COIL

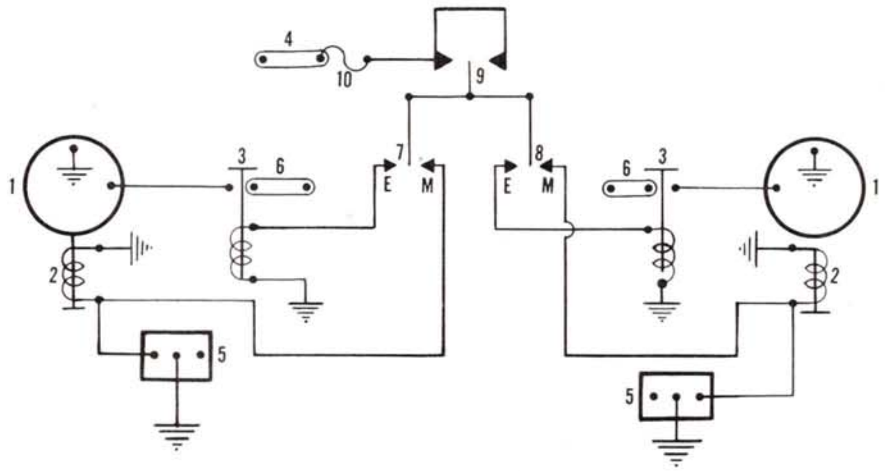
C-47 IGNITION CIRCUIT


OFF
R
L
1
4
2
3
R
L

1. IGNITION SWITCH
2. LEFT ENGINE MAGNETO
3. RIGHT ENGINE MAGNETO
4. INDUCTION VIBRATOR

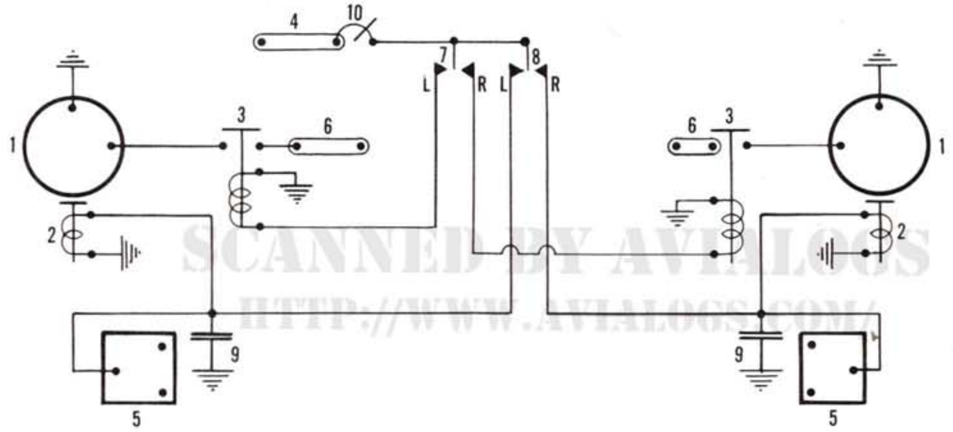
C-47A IGNITION CIRCUIT

Figure 472—Wiring Diagram
(Sheet 2 of 13 Sheets)



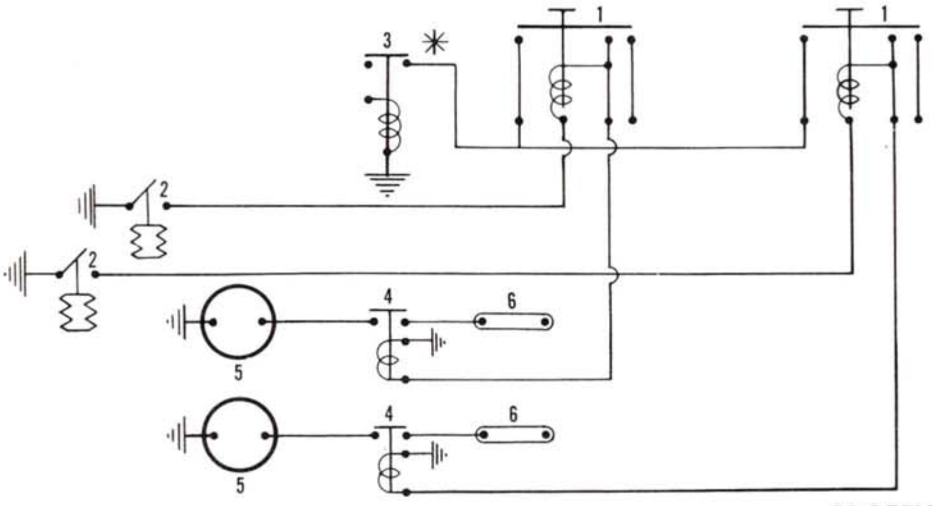
1. STARTER MOTOR
2. STARTER MESHING SOLENOID
3. STARTER RELAY
4. MAIN JUNCTION BOX FUSE BUS
5. BOOSTER COIL
6. FIREWALL JUNCTION BOX BUS
7. LEFT STARTER ("ENERGIZE" & "MESH") SWITCH
8. RIGHT STARTER ("ENERGIZE" & "MESH") SWITCH
9. STARTER SAFETY SWITCH
10. FUSE

C-47 STARTER CIRCUIT



1. STARTER MOTOR
2. STARTER MESHING SOLENOID
3. STARTER RELAY
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. INDUCTION VIBRATOR
6. FIREWALL JUNCTION BOX BUS BAR
7. "ENERGIZE" STARTER SWITCH
8. "MESH" STARTER SWITCH
9. CONDENSER
10. CIRCUIT BREAKER

C-47A STARTER CIRCUIT

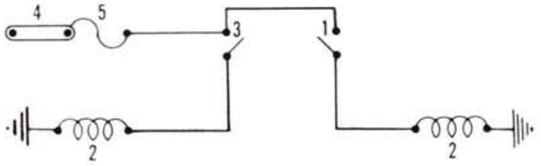


1. PROPELLER FEATHERING SWITCH
2. PRESSURE CUT-OUT SWITCH
3. BATTERY CONNECTOR RELAY
4. PROPELLER FEATHERING RELAY
5. PROPELLER FEATHERING PUMP MOTOR
6. FIREWALL JUNCTION BOX BUS

*On some airplanes, this circuit is connected to the main junction box fuse panel through a fuse.

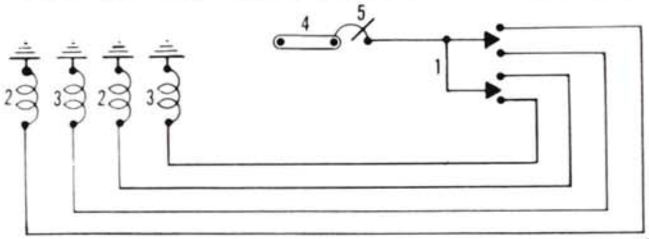
PROPELLER FEATHERING CIRCUIT

Figure 472—Wiring Diagram
(Sheet 3 of 13 Sheets)



1. R.H. OIL DILUTION SOLENOID SWITCH
2. OIL DILUTION SOLENOID
3. L.H. OIL DILUTION SOLENOID SWITCH
4. MAIN JUNCTION BOX FUSE BUS
5. FUSE

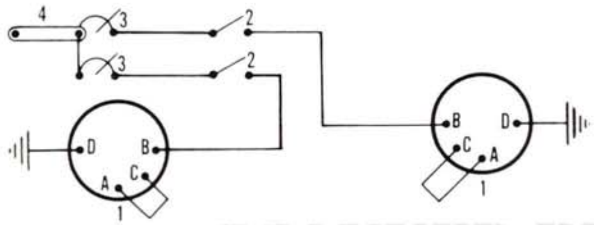
C-47 OIL DILUTION CIRCUIT



1. PILOT'S OIL DILUTION & ENGINE PRIMER CONTROL SWITCH
2. OIL DILUTION SOLENOID
3. ENGINE PRIMER SOLENOID*
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. CIRCUIT BREAKER (OR FUSE)

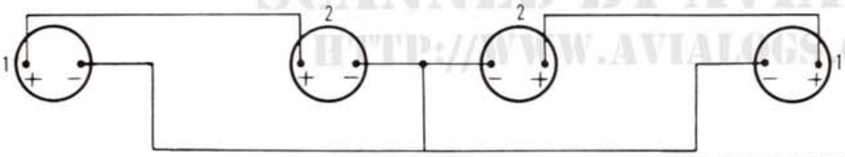
*On some airplanes, the engine primer solenoids and circuits are omitted.

C-47A OIL DILUTION & ENGINE PRIMER CIRCUIT



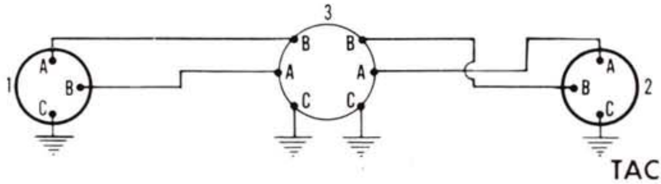
1. FUEL BOOSTER PUMP
2. FUEL BOOSTER PUMP SWITCH
3. CIRCUIT BREAKER
4. MAIN JUNCTION BOX CIRCUIT BREAKER BUS

FUEL BOOSTER PUMP CIRCUIT
(Used on late C-47A and all C-47B airplanes)



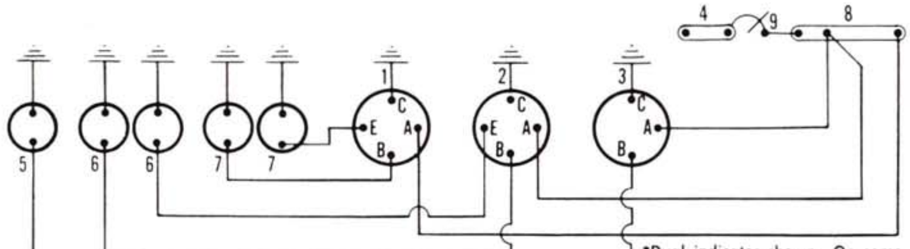
1. TACHOMETER MAGNETO
2. TACHOMETER

TACHOMETER CIRCUIT (Single Indicators)



1. L.H. ENGINE TACHOMETER GENERATOR
2. R.H. ENGINE TACHOMETER GENERATOR
3. TACHOMETER (DUAL)

TACHOMETER CIRCUIT (Dual Indicator)

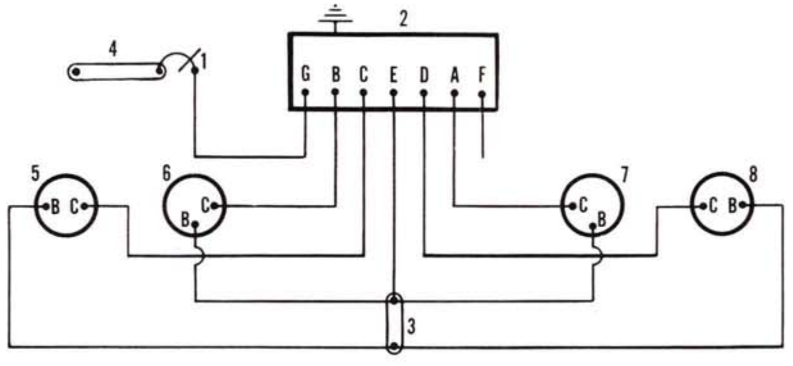


*Dual indicator shown. On some airplanes, each temperature bulb is wired to a separate indicator.

1. CARBURETOR AIR TEMPERATURE INDICATOR
2. ENGINE OIL TEMPERATURE INDICATOR
3. FREE AIR TEMPERATURE INDICATOR
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. FREE AIR TEMPERATURE BULB
6. ENGINE OIL TEMPERATURE BULB
7. CARBURETOR AIR TEMPERATURE BULB
8. INSTRUMENT PANEL JUNCTION BOX BUS
9. CIRCUIT BREAKER (OR FUSE)

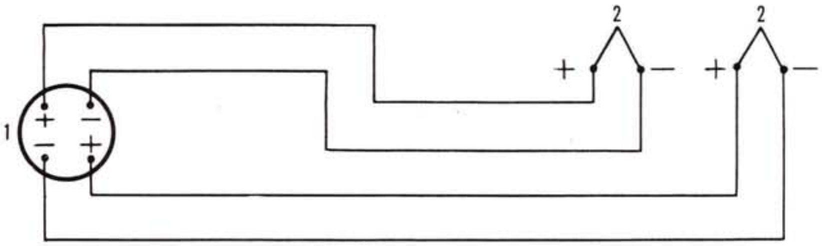
TEMPERATURE INSTRUMENTS CIRCUIT*

Figure 472—Wiring Diagram
(Sheet 4 of 13 Sheets)



1. CIRCUIT BREAKER (OR FUSE)
2. FUEL QUANTITY GAGE INDICATOR
3. CENTER WING JUNCTION BOX BUS
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS BAR
5. R.H. AUXILIARY FUEL TANK UNIT
6. R.H. MAIN FUEL TANK UNIT
7. L.H. MAIN FUEL TANK UNIT
8. L.H. AUXILIARY FUEL TANK UNIT

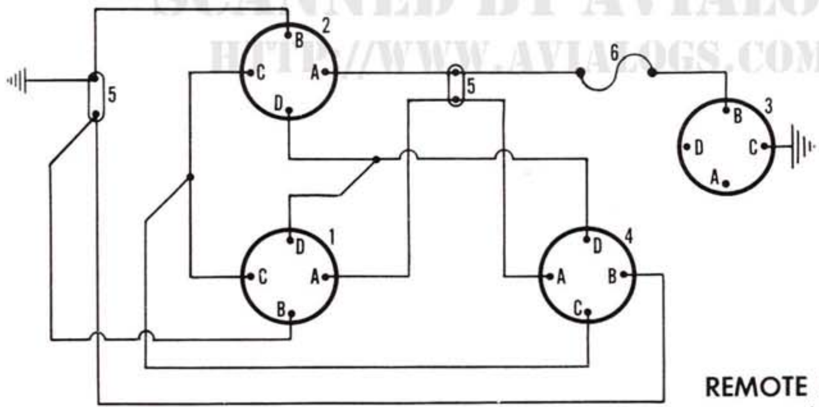
FUEL QUANTITY GAGE CIRCUIT



1. ENGINE TEMPERATURE INDICATOR*
2. THERMOCOUPLE

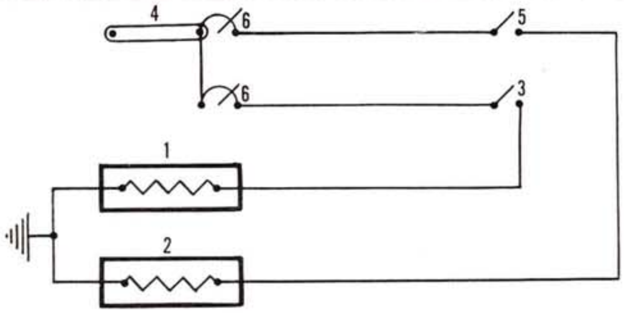
*Dual indicator shown. On some airplanes, each thermocouple is wired to a separate indicator.

ENGINE TEMPERATURE GAGE CIRCUIT



1. PILOT'S COMPASS INDICATOR
2. NAVIGATOR'S COMPASS INDICATOR
3. INVERTER
4. COMPASS TRANSMITTER
5. TUNNEL BUS
6. INVERTER RELAY PANEL FUSE

REMOTE INDICATING COMPASS CIRCUIT
(On some airplanes only)

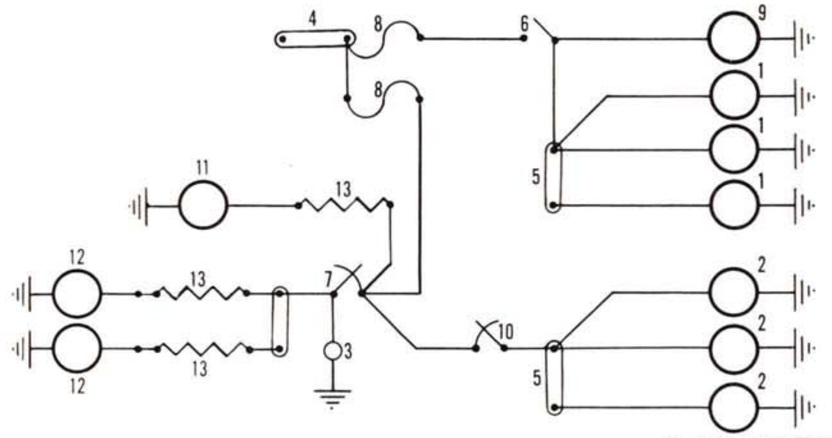


1. FORWARD PITOT TUBE
2. AFT PITOT TUBE
3. FORWARD PITOT HEATER SWITCH
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. AFT PITOT HEATER SWITCH
6. CIRCUIT BREAKER (OR FUSE)

PITOT TUBE HEATER CIRCUIT

14,487

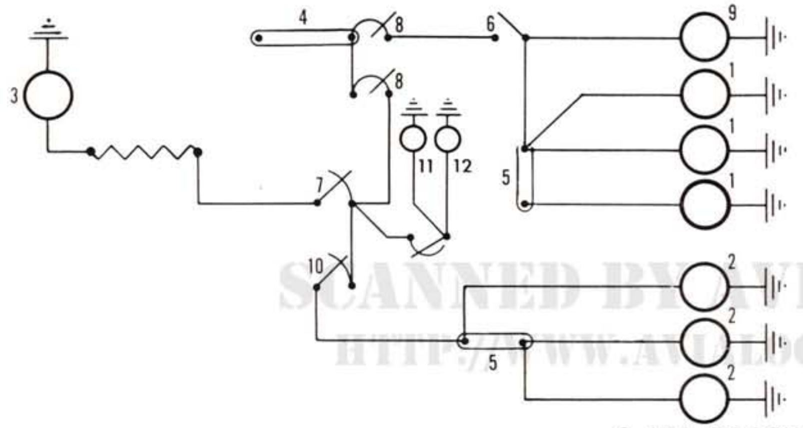
Figure 472—Wiring Diagram
(Sheet 5 of 13 Sheets)



1. AFT "COCKPIT" LAMP
2. FORWARD "COCKPIT" LAMP
3. COMPASS LAMP
4. MAIN JUNCTION BOX FUSE BUS
5. TUNNEL BUS
6. AFT "COCKPIT LAMPS" SWITCH
7. "COMPASS LAMP" RHEOSTAT
8. FUSE
9. VOLTAMMETER LAMP
10. "PANEL LAMPS" RHEOSTAT
11. TUNING CONTROL LAMP*
12. AUTO PILOT LAMP*
13. RESISTOR*

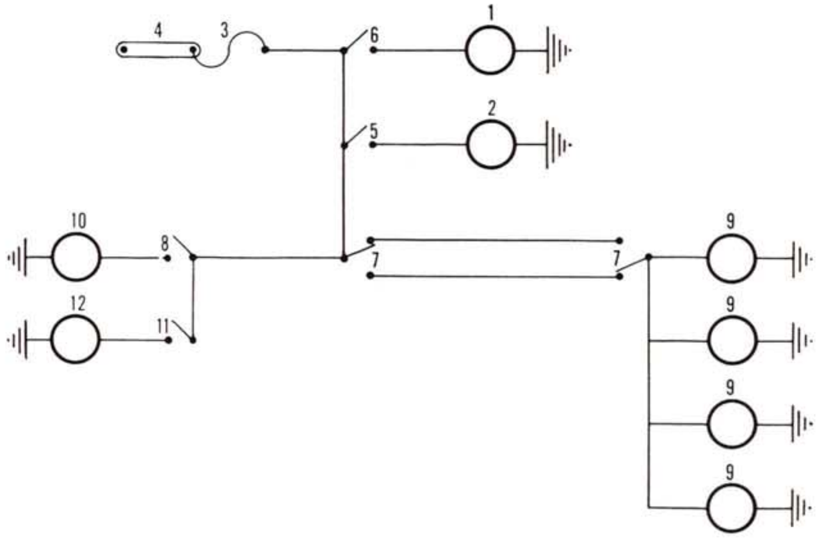
*On some airplanes only

C-47 PILOTS' COMPARTMENT LAMPS CIRCUIT



1. AFT "COCKPIT" LAMP
2. FORWARD "COCKPIT" LAMP
3. COMPASS LAMP
4. MAIN JUNCTION BOX CIRCUIT BREAKER (FUSE) BUS
5. TUNNEL BUS
6. AFT "COCKPIT LAMPS" CONTROL SWITCH
7. "COMPASS LAMP" CONTROL RHEOSTAT
8. CIRCUIT BREAKER (OR FUSE)
9. AMMETER LAMP
10. "PANEL LAMPS" RHEOSTAT
11. COMMAND RADIO LAMP
12. COMMAND RADIO LAMP

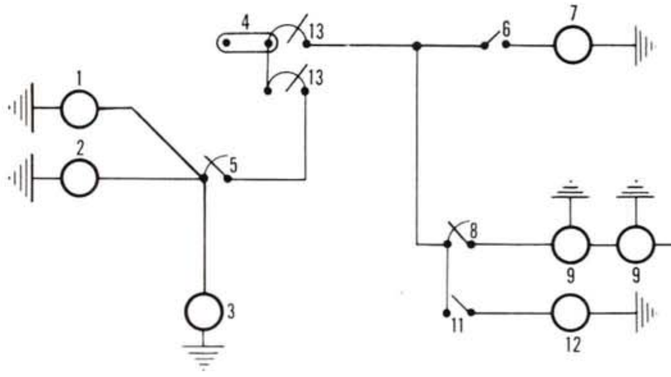
C-47A PILOTS' COMPARTMENT LAMPS CIRCUIT



1. FORWARD PASSAGEWAY DOME LAMP
2. RADIO OPERATOR'S COMPARTMENT DOME LAMP
3. FUSE
4. MAIN JUNCTION BOX FUSE BUS
5. RADIO OPERATOR'S DOME LAMP SWITCH
6. FORWARD PASSAGEWAY DOME LAMP SWITCH
7. MAIN CARGO COMPARTMENT DOME LAMP SWITCH
8. LAVATORY LAMP SWITCH
9. MAIN CARGO COMPARTMENT DOME LAMP
10. LAVATORY DOME LAMP
11. TAIL CONE LAMP SWITCH
12. TAIL CONE DOME LAMP

DOME LAMPS CIRCUIT (Original)

Figure 472—Wiring Diagram (Sheet 6 of 13 Sheets)

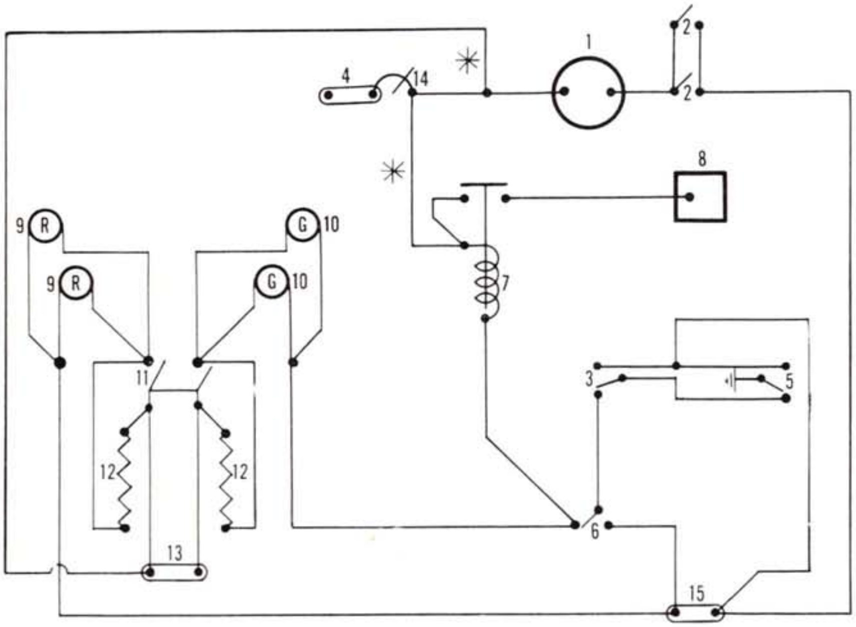


1. RADIO OPERATOR'S COMPARTMENT DOME LAMP
2. FORWARD PASSAGEWAY DOME LAMP
3. NAVIGATOR'S COMPARTMENT DOME LAMP
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. FORWARD DOME LAMPS CONTROL RHEOSTAT
6. NAVIGATOR'S WORK TABLE LAMP CONTROL SWITCH
7. NAVIGATOR'S WORK TABLE LAMP
8. AFT DOME LAMPS CONTROL RHEOSTAT
9. MAIN CARGO COMPARTMENT DOME LAMP
10. LAVATORY DOME LAMP
11. TAIL CONE COMPARTMENT DOME LAMP CONTROL SWITCH
12. TAIL CONE COMPARTMENT DOME LAMP
13. CIRCUIT BREAKER

DOME LAMPS CIRCUIT (Revised)

14,488

Figure 472—Wiring Diagram
(Sheet 7 of 13 Sheets)



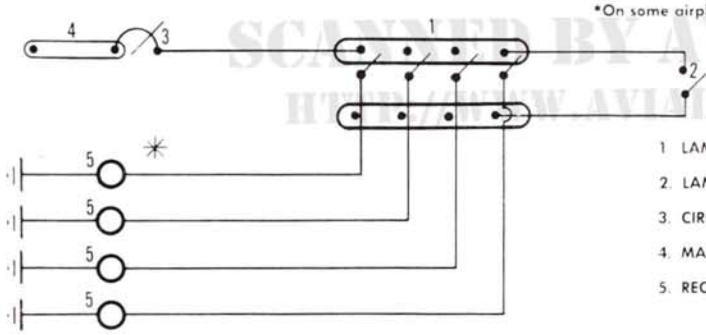
1. WARNING HORN
2. THROTTLE LIMIT SWITCH
3. L.H. LANDING GEAR LIMIT SWITCH
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. R.H. LANDING GEAR LIMIT SWITCH
6. HYDRAULIC LANDING GEAR CONTROL VALVE LIMIT SWITCH
7. TRAILING ANTENNA WARNING LAMP RELAY
8. TRAILING ANTENNA REEL CONTROL BOX
9. RED LANDING GEAR WARNING LAMP
10. GREEN LANDING GEAR WARNING LAMP
11. WARNING LAMPS DIMMING SWITCH
12. RESISTOR
13. INSTRUMENT PANEL JUNCTION BOX BUS
14. CIRCUIT BREAKER (OR FUSE)
15. TUNNEL BUS

*On some airplanes, the relay (item No. 7) and the lamps (items Nos. 9 & 10) are connected to the bus (item No. 4) through a separate fuse.

LANDING GEAR WARNING LAMPS CIRCUIT

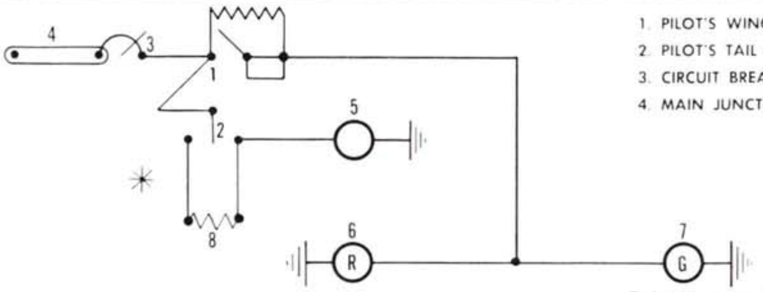
Used on C-47A and Early C-47B Airplanes

*On some airplanes, the upper recognition lamp and switch are omitted



1. LAMPS CONTROL SWITCH
2. LAMPS KEYING CONTROL SWITCH
3. CIRCUIT BREAKER (OR FUSE)
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. RECOGNITION LAMP*

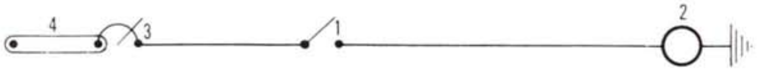
RECOGNITION LAMPS CIRCUIT



1. PILOT'S WING TIP POSITION LAMPS CONTROL SWITCH
2. PILOT'S TAIL CONE POSITION LAMPS CONTROL SWITCH*
3. CIRCUIT BREAKER (OR FUSE)
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. TAIL CONE LAMP
6. L.H. WING TIP (RED) LAMP
7. R.H. WING TIP (GREEN) LAMP
8. RESISTOR*

*On some airplanes the tail cone switch and resistor are omitted

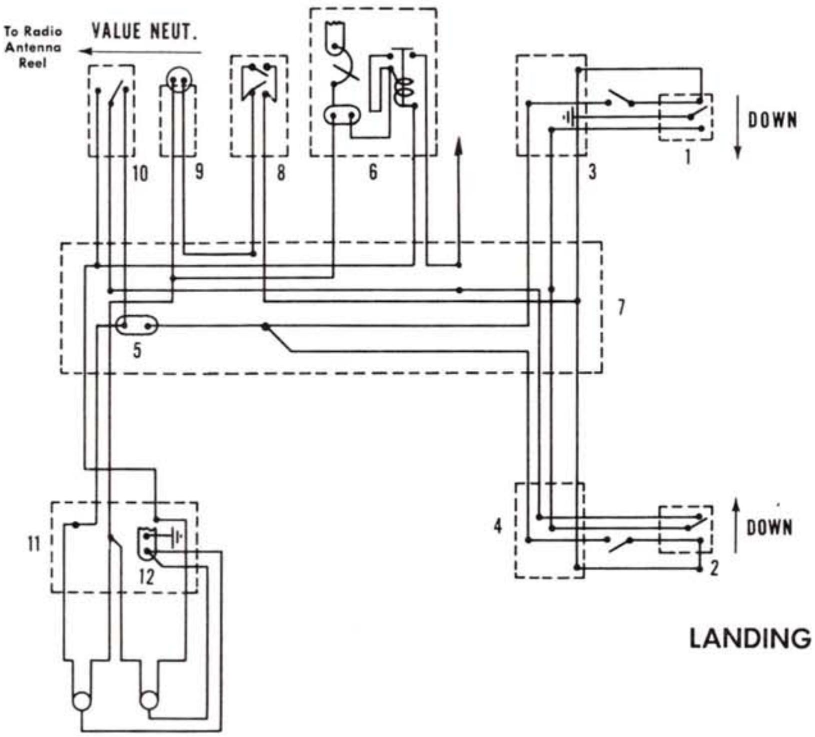
POSITION (RUNNING) LAMPS CIRCUIT



1. PILOT'S CONTROL SWITCH
2. PASSING LAMP
3. CIRCUIT BREAKER (OR FUSE)
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS

PASSING LAMP CIRCUIT

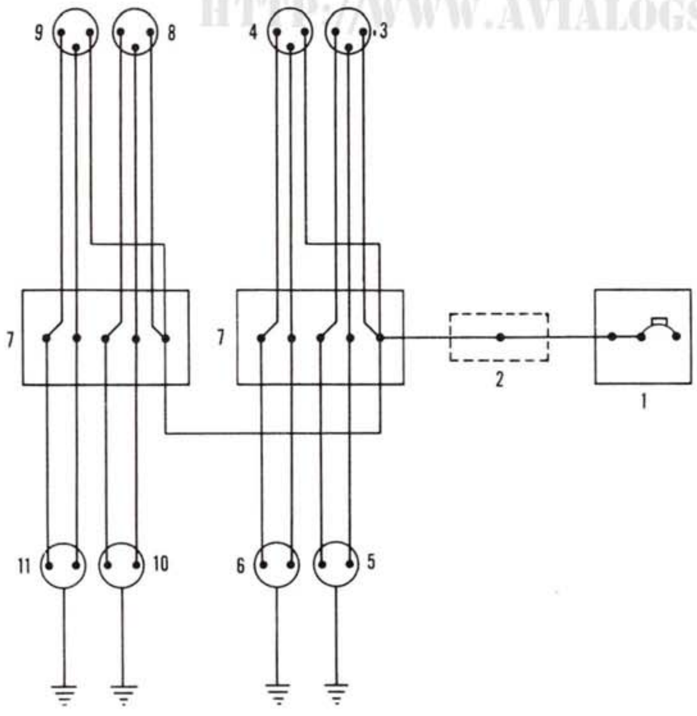
Figure 472—Wiring Diagram
(Sheet 8 of 13 Sheets)


To Radio Antenna Reel
VALUE NEUT.
10
9
8
6
3
1
DOWN
7
5
4
DOWN
2
11
12

1. R.H. GEAR LIMIT SWITCH
2. L.H. GEAR LIMIT SWITCH
3. R.H. NACELLE JUNCTION BOX
4. L.H. NACELLE JUNCTION BOX
5. TUNNEL BUS
6. MAIN JUNCTION BOX
7. TUNNEL
8. THROTTLE LIMIT SWITCH
9. HORN
10. HYDRAULIC VALVE SWITCH
11. INSTRUMENT PANEL
12. INSTRUMENT PANEL BUS

LANDING GEAR WARNING LAMP CIRCUIT

Late C-47B Airplanes

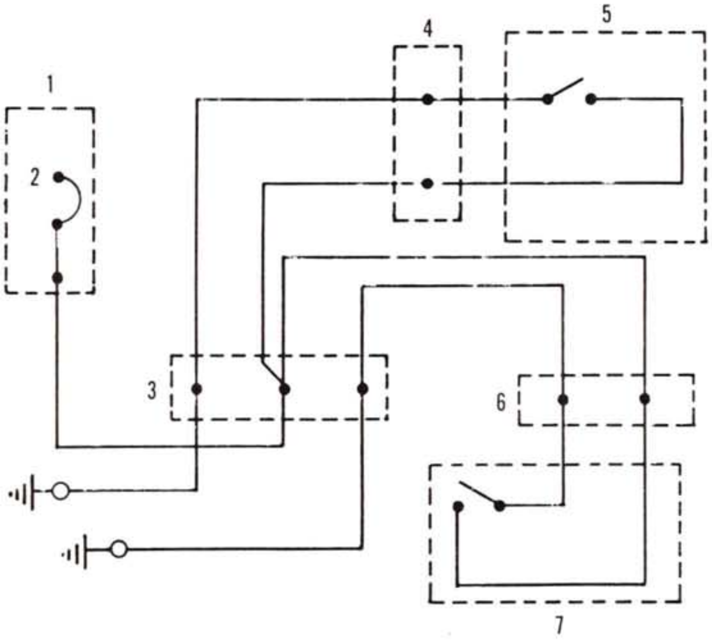

9
8
4
3
7
7
2
1
11
10
6
5

1. MAIN JUNCTION BOX
2. TUNNEL
3. L.H. OUTBOARD CONTROL
4. L.H. PEDESTAL CONTROL
5. L.H. OUTBOARD LIGHT
6. L.H. PEDESTAL LIGHT
7. TERMINAL STRIP
8. R.H. PEDESTAL CONTROL
9. R.H. OUTBOARD CONTROL
10. R.H. PEDESTAL LIGHT
11. R.H. OUTBOARD LIGHT

FLUORESCENT LIGHTING

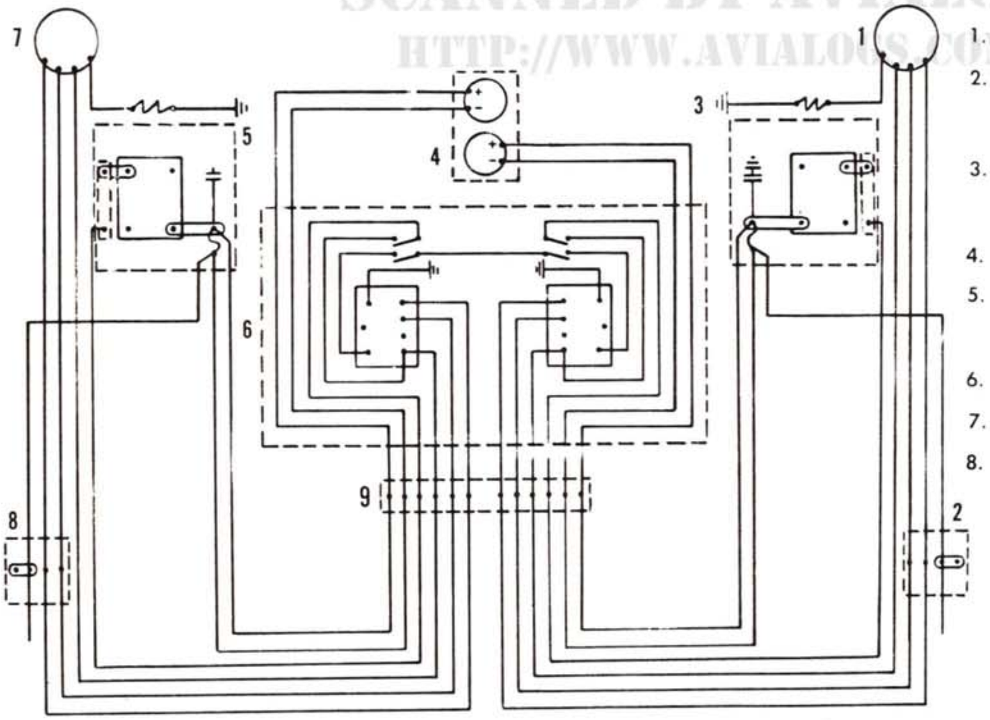
14,489

Figure 472—Wiring Diagram
(Sheet 8A of 13 Sheets)



1. MAIN JUNCTION BOX
2. CIRCUIT BREAKER
3. TUNNEL
4. R.H. FIREWALL JUNCTION BOX
5. R.H. ENGINE
6. L.H. FIREWALL JUNCTION BOX
7. L.H. ENGINE

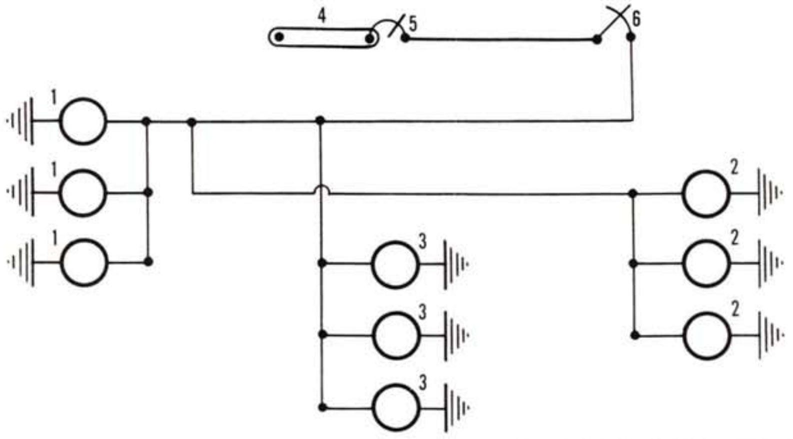
BLOWER WARNING CIRCUIT



1. R.H. GENERATOR
2. R.H. FIREWALL JUNCTION BOX
3. R.H. REVERSE CURRENT RELAY BOX
4. PILOT'S ELECTRICAL PANEL
5. L.H. REVERSE CURRENT RELAY BOX
6. MAIN JUNCTION BOX
7. L.H. GENERATOR
8. L.H. FIREWALL JUNCTION BOX
9. TUNNEL

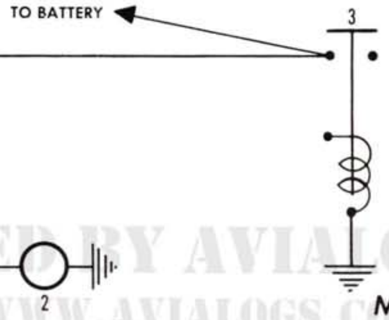
C-47B GENERATOR CIRCUIT

Figure 472—Wiring Diagram
(Sheet 8B of 13 Sheets)



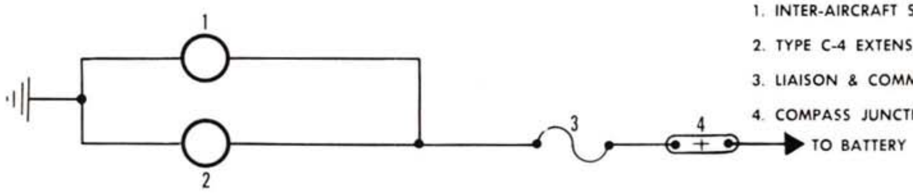
1. L.H. WING FORMATION LAMP
2. R.H. WING FORMATION LAMP
3. FUSELAGE FORMATION LAMP
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. CIRCUIT BREAKER
6. PILOTS' FORMATION LAMPS CONTROL RHEOSTAT

FORMATION LAMPS CIRCUIT (On some airplanes only)



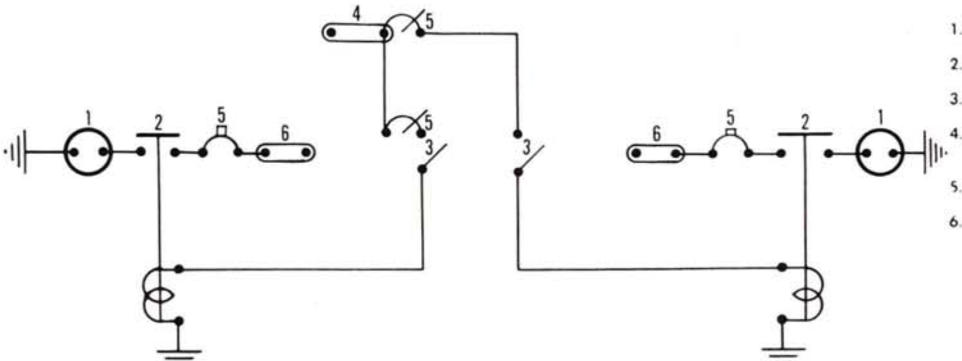
1. JUNCTION BOX COVER CONTROL SWITCH
2. LAMP
3. BATTERY CONNECTOR RELAY (R.H. RELAY ON C-47)

MAIN JUNCTION BOX LAMP CIRCUIT



1. INTER-AIRCRAFT SIGNAL LAMP
2. TYPE C-4 EXTENSION LAMP
3. LIAISON & COMMAND JUNCTION BOX FUSE
4. COMPASS JUNCTION BOX POWER BUS

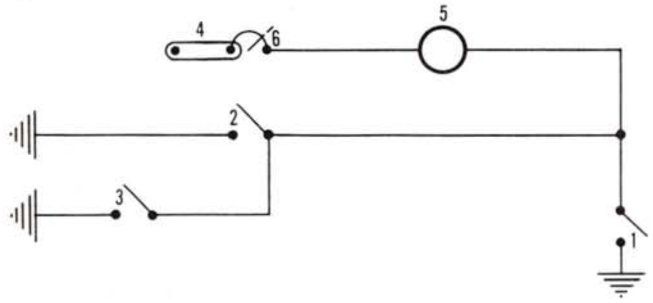
INTER-AIRCRAFT & EXTENSION LAMPS CIRCUIT



1. LANDING LAMP
2. LANDING LAMP RELAY
3. LANDING LAMP CONTROL SWITCH
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. CIRCUIT BREAKER (OR FUSE)
6. FIREWALL JUNCTION BOX BUS

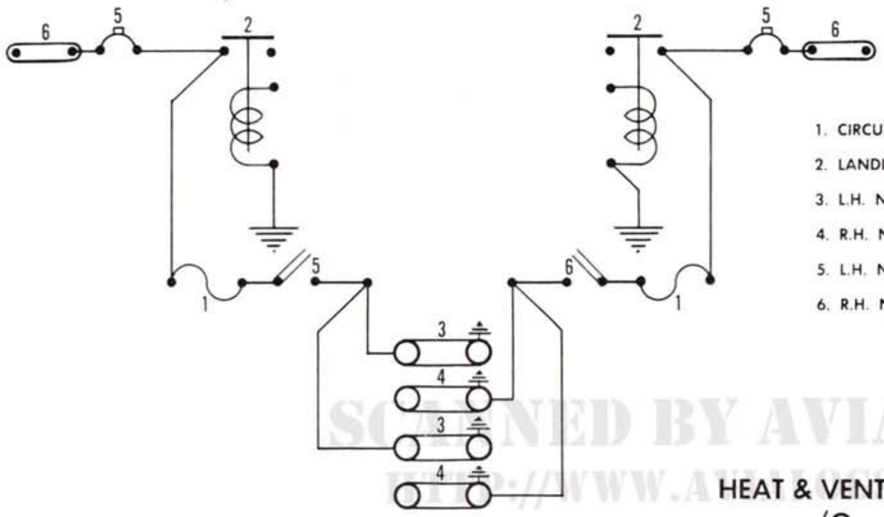
LANDING LAMPS CIRCUIT

Figure 472—Wiring Diagram
(Sheet 9 of 13 Sheets)



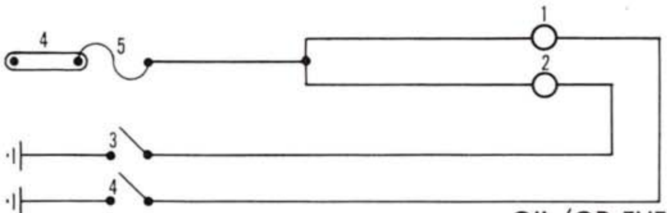
1. FORWARD DOOR WARNING SWITCH
2. AFT CARGO DOOR WARNING SWITCH
3. FORWARD CARGO DOOR WARNING SWITCH
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. WARNING LAMP
6. CIRCUIT BREAKER (OR FUSE)

DOOR OPEN WARNING LAMPS CIRCUIT



1. CIRCUIT BREAKER
2. LANDING LAMP RELAY
3. L.H. NACELLE HEAT & VENT WARNING LAMP
4. R.H. NACELLE HEAT & VENT WARNING LAMP
5. L.H. NACELLE THERMOSTAT SWITCH
6. R.H. NACELLE THERMOSTAT SWITCH

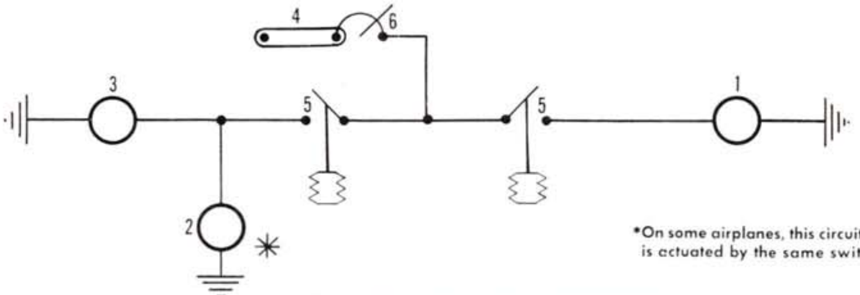
HEAT & VENT WARNING LAMPS CIRCUIT
(On some airplanes only)



1. L.H. ENGINE WARNING LAMP
2. R.H. ENGINE WARNING LAMP
3. R.H. FIREWALL WARNING SWITCH
4. L.H. FIREWALL WARNING SWITCH
5. FUSE

*Fuel pressure warning lamp circuit is identical to this circuit.

OIL (OR FUEL*) PRESSURE WARNING LAMPS CIRCUIT
(On some airplanes only)

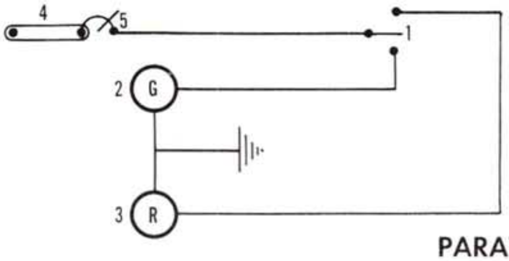


1. PILOT'S WARNING LAMP
2. NAVIGATOR'S WARNING LAMP*
3. CO-PILOT'S WARNING LAMP
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. OXYGEN PRESSURE SWITCH
6. CIRCUIT BREAKER

*On some airplanes, this circuit is wired so that the navigator's warning lamp is actuated by the same switch which actuates the pilot's warning lamp.

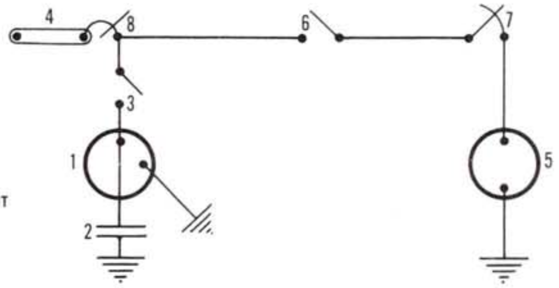
OXYGEN PRESSURE WARNING LAMPS CIRCUIT (On some airplanes only)

Figure 472—Wiring Diagram
(Sheet 10 of 13 Sheets)



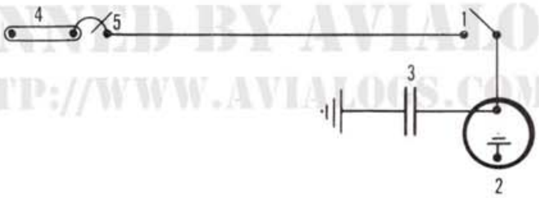
1. PILOT'S CONTROL SWITCH
2. GREEN WARNING LAMP
3. RED WARNING LAMP
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. CIRCUIT BREAKER (OR FUSE)

PARATROOP WARNING LAMPS CIRCUIT



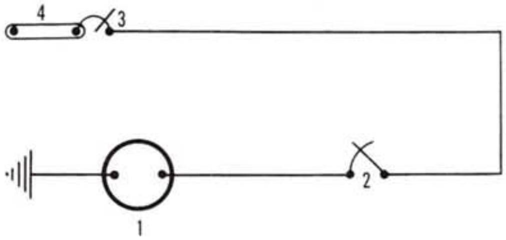
1. SURFACES DE-ICER MOTOR
2. SURFACES DE-ICER MOTOR CONDENSER
3. SURFACES DE-ICER MOTOR CONTROL SWITCH
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. PROPELLER DE-ICER MOTOR
6. PROPELLER DE-ICER MOTOR CONTROL SWITCH
7. PROPELLER DE-ICER MOTOR CONTROL RHEOSTAT
8. CIRCUIT BREAKER (OR FUSE)

SURFACES & PROPELLER DE-ICER MOTORS CIRCUIT



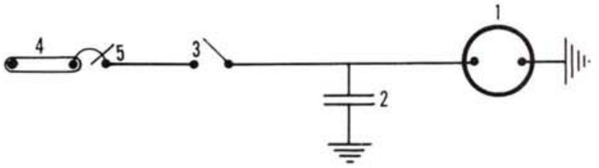
1. PILOT'S CONTROL SWITCH
2. WINDSHIELD DE-ICER PUMP
3. CONDENSER
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. CIRCUIT BREAKER (OR FUSE)

WINDSHIELD DE-ICER PUMP CIRCUIT



1. CARBURETOR DE-ICER PUMP
2. PILOT'S CONTROL SWITCH
3. CIRCUIT BREAKER (OR FUSE)
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS

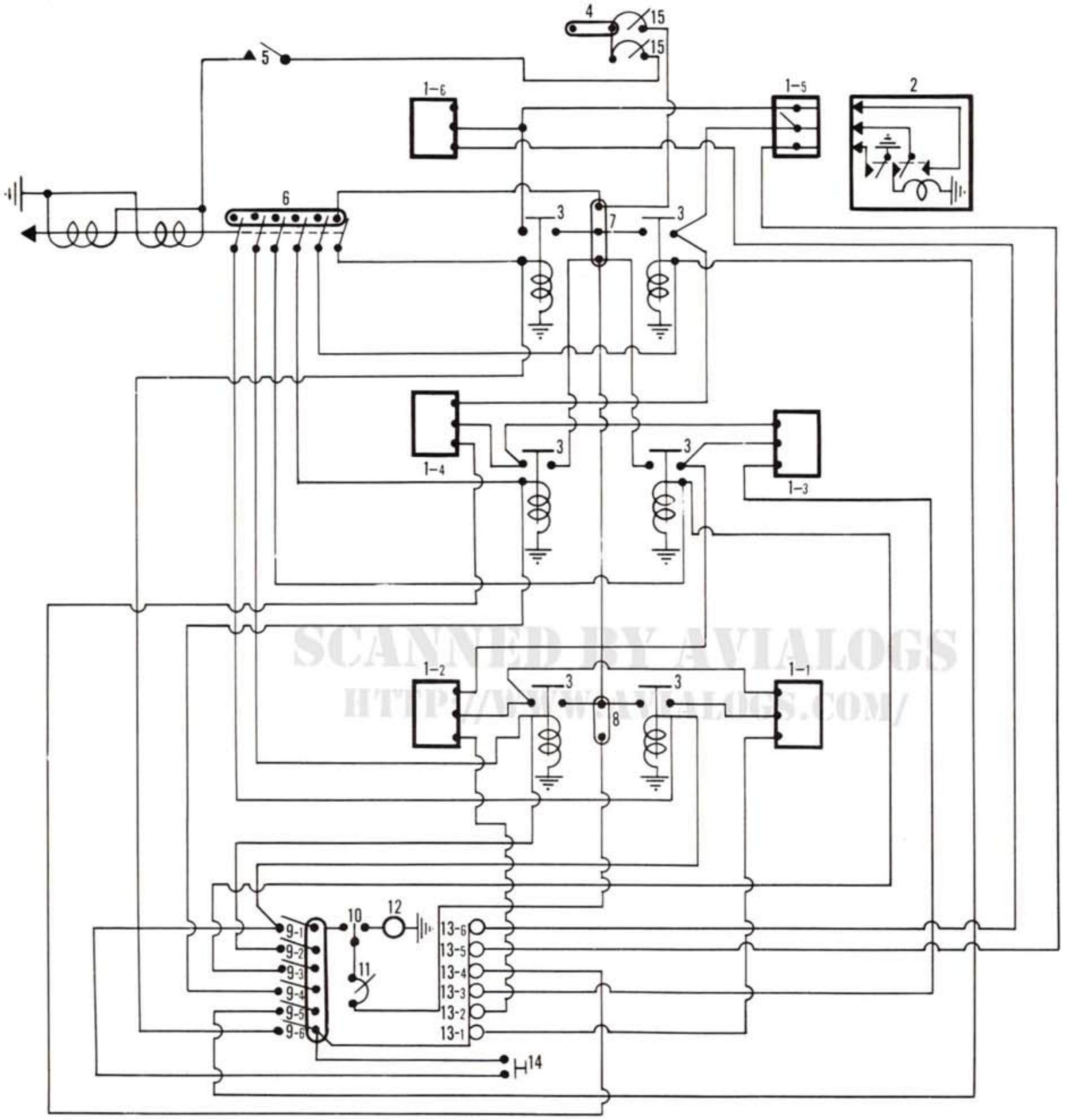
CARBURETOR DE-ICER CIRCUIT



1. DEFROSTER BLOWER
2. CONDENSER
3. SWITCH
4. MAIN JUNCTION BOX CIRCUIT BREAKER BUS
5. CIRCUIT BREAKER (OR FUSE)

WINDSHIELD DEFROSTER BLOWER CIRCUIT (On some airplanes only)

Figure 472—Wiring Diagram
(Sheet 11 of 13 Sheets)

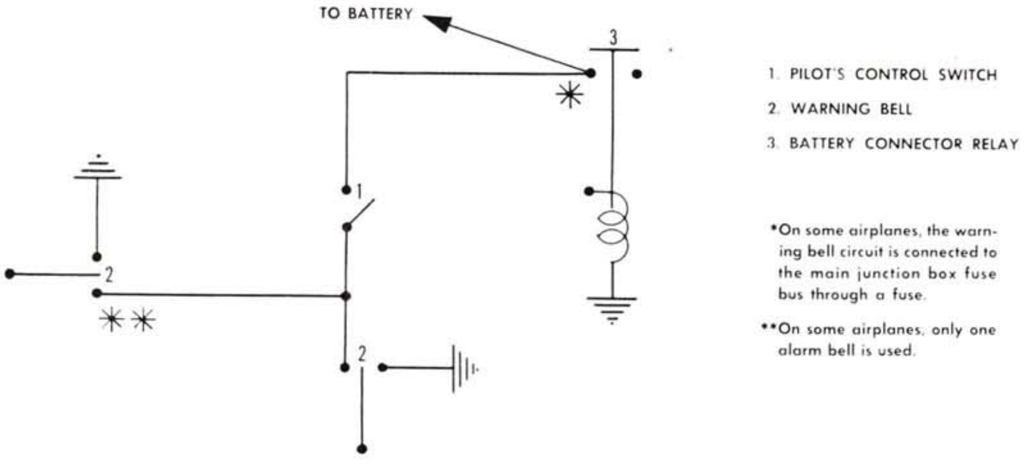

4
15
15
5
1-6
1-5
2
6
3
7
3
1-4
3
3
1-3
1-2
3
3
1-1
8
10
12
11
9-1
9-2
9-3
9-4
9-5
9-6
13-6
13-5
13-4
13-3
13-2
13-1
14

1. RELEASE MECHANISM RECEPTACLE*
2. RELEASE MECHANISM (TYPICAL OF ANY OF THE SIX PARAPACK STATIONS)
3. RELEASE RELAY
4. MAIN JUNCTION BOX CIRCUIT BREAKER (OR FUSE) BUS
5. PILOT'S PARAPACK SALVO RELEASE CONTROL SWITCH
6. SALVO RELEASE RELAY
7. CENTER PARAPACK JUNCTION BOX BUS
8. AFT PARAPACK JUNCTION BOX BUS
9. PARAPACK CONTROL BOX RELEASE SWITCH*
10. PARAPACK CONTROL BOX MASTER SWITCH
11. PARAPACK CONTROL BOX CIRCUIT BREAKER SWITCH
12. PARAPACK CONTROL BOX RED WARNING LAMP
13. PARAPACK CONTROL BOX GREEN INDICATOR LAMP*
14. HANDSWITCH
15. CIRCUIT BREAKER (OR FUSE)

*Dash numbers are used to signify the parapack station numbers.

PARAPACK CIRCUIT

Figure 472—Wiring Diagram
(Sheet 12 of 13 Sheets)

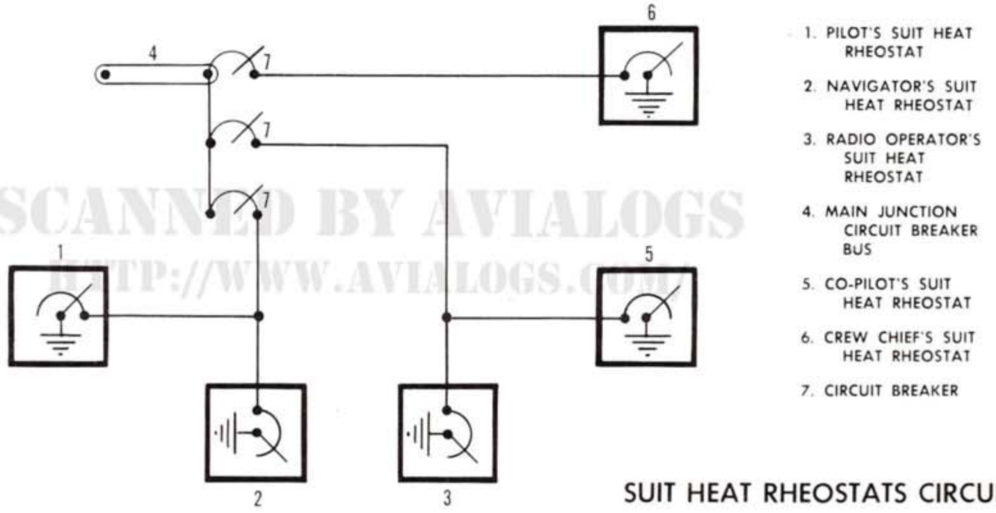


1. PILOT'S CONTROL SWITCH
2. WARNING BELL
3. BATTERY CONNECTOR RELAY

*On some airplanes, the warning bell circuit is connected to the main junction box fuse bus through a fuse.

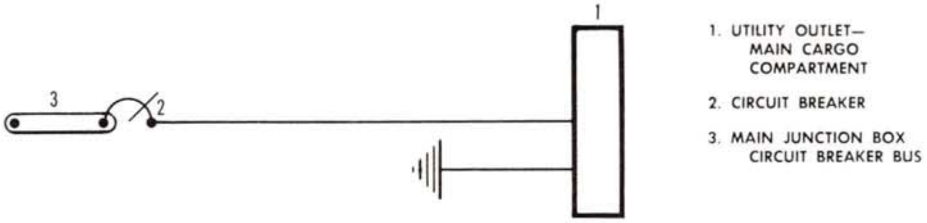
**On some airplanes, only one alarm bell is used.

WARNING BELL CIRCUIT



1. PILOT'S SUIT HEAT RHEOSTAT
2. NAVIGATOR'S SUIT HEAT RHEOSTAT
3. RADIO OPERATOR'S SUIT HEAT RHEOSTAT
4. MAIN JUNCTION CIRCUIT BREAKER BUS
5. CO-PILOT'S SUIT HEAT RHEOSTAT
6. CREW CHIEF'S SUIT HEAT RHEOSTAT
7. CIRCUIT BREAKER

SUIT HEAT RHEOSTATS CIRCUIT



1. UTILITY OUTLET—MAIN CARGO COMPARTMENT
2. CIRCUIT BREAKER
3. MAIN JUNCTION BOX CIRCUIT BREAKER BUS

UTILITY OUTLET CIRCUIT (On some airplanes only)

Figure 472—Wiring Diagram
(Sheet 13 of 13 Sheets)

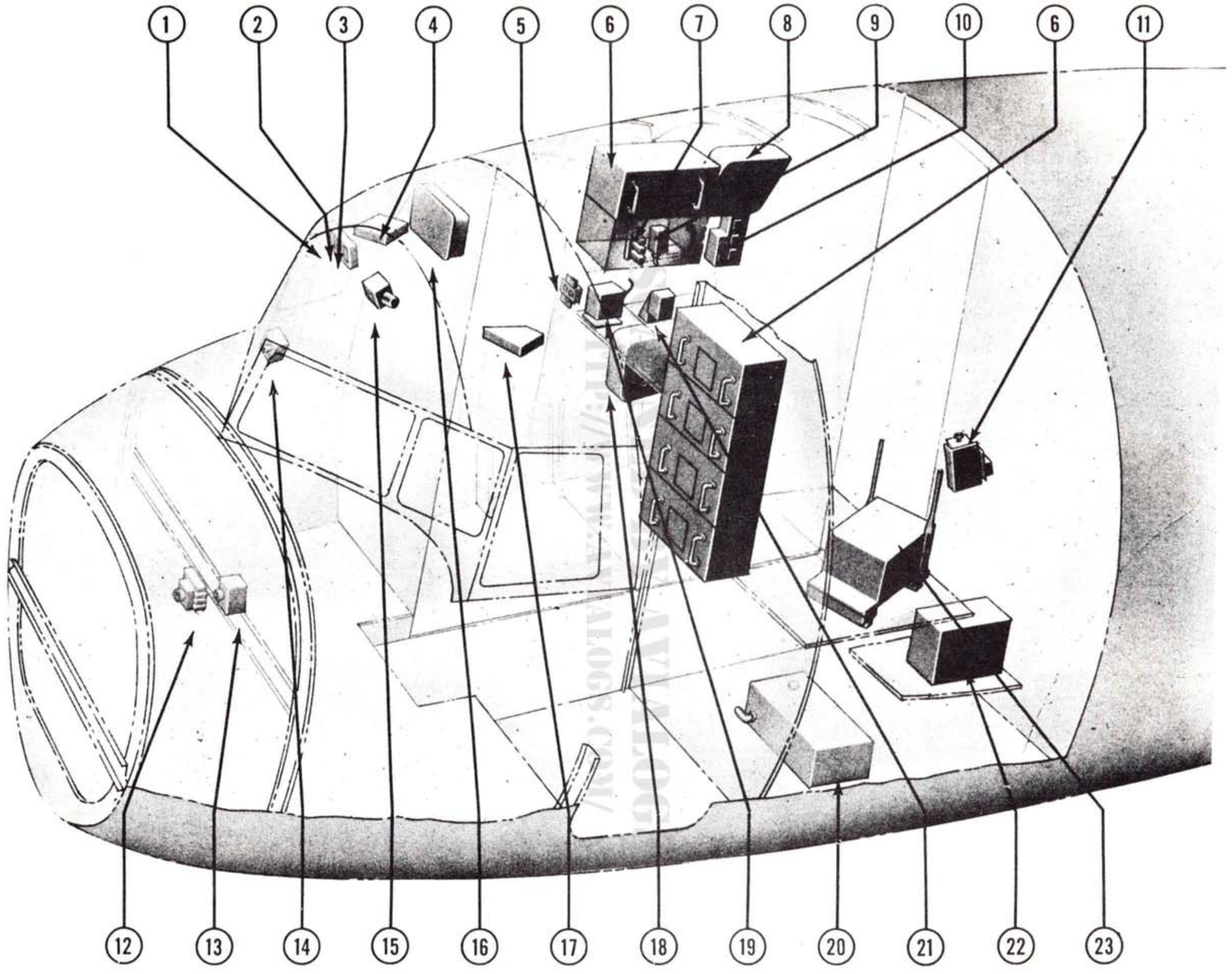
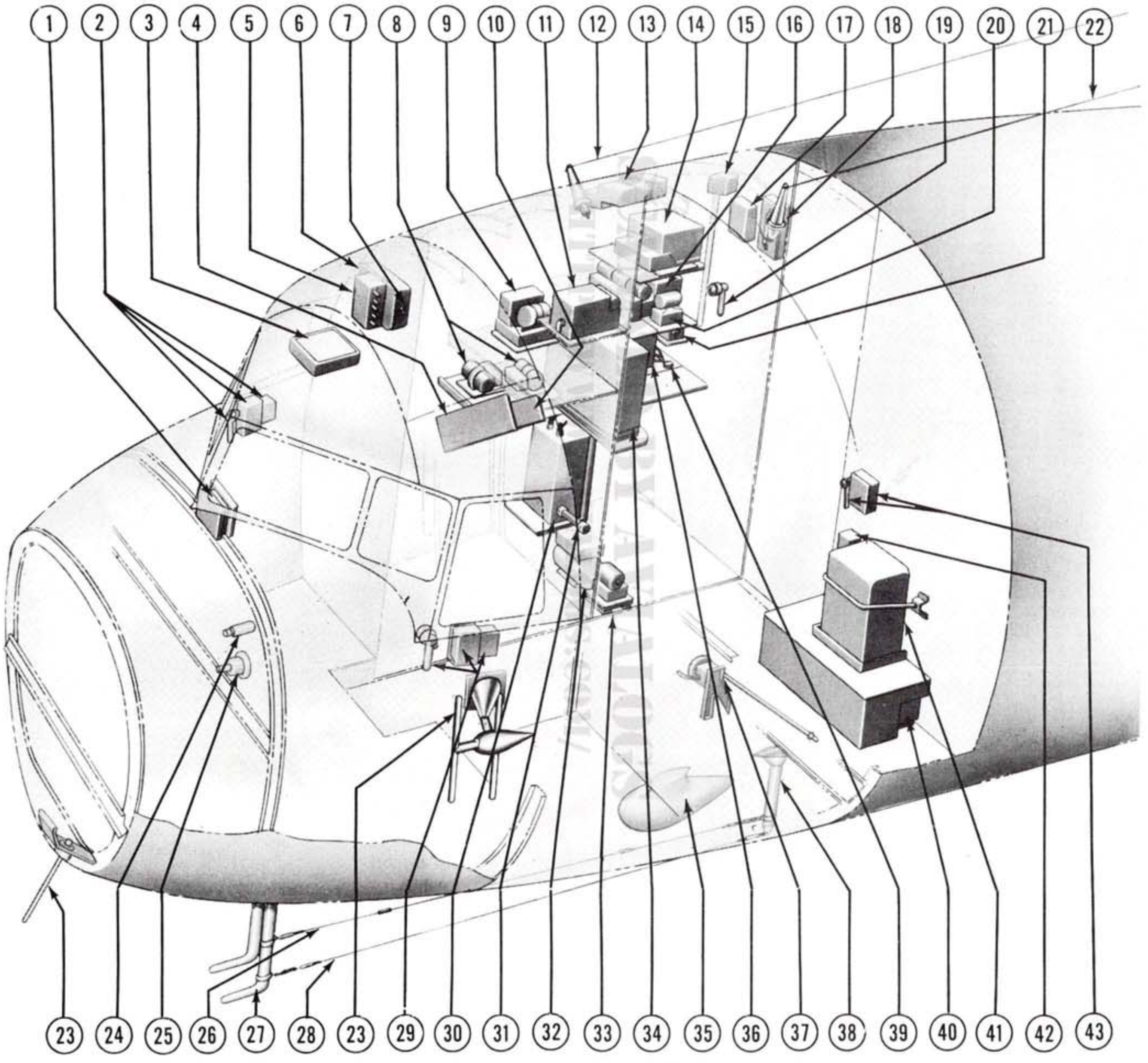

1
2
3
4
5
6
7
8
9
10
6
11
12
13
14
15
16
17
18
19
20
21
22
23

Figure 473—Communications System (Sheet 1 of 3 Sheets)


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
23
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43

14,491

Figure 473—Communications System (Sheet 2 of 3 Sheets)

KEY TO FIGURE 473—(Sheet 1 of 3 Sheets)

1. *AN/ARR-1 Control Switch
2. Radio Compass C-W Remote Control Switch
3. VHF—Medium Frequency Command Radios Selector Switch
4. SCR-( )-183 Command Transmitter Control Box
5. Pilot's IFF Control Switches
6. Liaison Transmitter Spare Tuning Units
7. Liaison Antenna Changeover Switch
8. Liaison and Command Junction Box
9. Liaison Trailing Antenna Reel Control Box
10. IFF (SCR-595-( ) or 695-( ) Control Box
11. *AN/APN-2 Control Box
12. *AN/APN-1 Radio Altimeter Indicator and Limit Lamps
13. RC-103-( ) Indicator
14. *AN/APN-1 Radio Altimeter Limit Switch
15. RC-103-( ) Control Box
16. Copilot's Radio Junction Box
17. SCR-( )-183 Command Receiver Control Box
18. Compass Junction Box
19. Marker Beacon Receiver
20. SCR-280-A Radio Compass Receiver Unit
21. Radio Operator's Interphone Jack Box
22. *AN/APN-2 Transmitter-Receiver Unit
23. *AN/APN-2 Indicator

KEY TO FIGURE 473—(Sheet 2 of 3 Sheets)

1. SCR-280-A Radio Compass Bearing Indicator
2. Copilot's Interphone Jack Box, Filter Unit, and Microphone
3. SCR-269-G (or SCR-280-A) Radio Compass Remote Control Box
4. SCR-274-N Command Receiver Remote Control Unit
5. SCR-522-( ) Command Radio Control Box
6. Copilot's Radio Junction Box
7. Liaison Transmitter Remote Control Switch
8. Inverters (Only One Inverter on Most Airplanes)
9. SCR-274-N Command Modulator and Dynamotor Unit
10. SCR-274-N Command Transmitter Remote Control Unit
11. RC-103-( ) Receiver and Dynamotor Unit
12. Command Radio Antenna
13. SCR-( )-183 Command Transmitter Spare Coil Units
14. SCR-274-N Command Transmitters
15. Command Antenna Switching Relay
16. SCR-274-N Command Receivers or
    SCR-( )-183 Command Receiver and Transmitter
17. Interphone Amplifier
18. SCR-( )-183 Command Receiver Spare Coil Unit
19. Radio Operator's Microphone
20. Interphone Dynamotor (C-47A Only)
21. *AN/ARR-1 Receiver
22. Liaison Radio Antenna
23. *AN/APN-2 Antennas
24. Marker Beacon Indicator Lamp
25. SCR-280-A Radio Compass Left-Right Indicator or
    SCR-269-G Bearing Indicator
26. Marker Beacon Antenna
27. Pitot Tubes (Ref.)
28. Radio Compass Nondirectional Antenna
29. Pilot's Interphone Jack Box, Filter Unit, and Microphone
30. Liaison Transmitter Antenna Tuning Unit.
31. Radio Compass Loop Antenna Dehydrator
32. Liaison Radio Dynamotor
33. SCR-( )-183 Command Radio Dynamotor
34. Liaison Radio Transmitter
35. Radio Compass Loop Antenna
36. Liaison Radio Receiver
37. Liaison Radio Trailing Antenna and Reel
38. Antenna Mast
39. Radio Operator's C-W Key
40. SCR-269-G Radio Compass Receiver
41. Frequency Meter
42. *AN/ARR-1 Relay Unit
43. Navigator's Interphone Jack Box and Microphone

15. COMMUNICATIONS EQUIPMENT.

Note

This paragraph includes the 12-volt C-47 communication system, the 24-volt C-47A communications system, and the 24-volt C-47B communications system. The 12-volt C-47 system begins with paragraph 15.*a.*, the 24-volt C-47A system begins with paragraph 15.*k.*, and the 24-volt C-47B system begins with paragraph 15.*z.* (See figure 473.)

a. GENERAL (12-VOLT C-47).—The radio sets installed in the C-47 airplane are as follows: command radio set SCR-( )-183 for communication from airplane to airplane or airplane to station in short range operation, liaison radio set SCR-187-A for communication from airplane to airplane or airplane to station in long range operation, radio compass SCR-280-A or SCR-269-G for navigational purposes, marker beacon receiving equipment RC-39-( ) for navigation and landing, frequency meter set SCR-211-( ) for test and adjustment of radio sets, and interphone equipment RC-45 for crew member communication and for crew member participation in the radio operations. On some airplanes, radio set SCR-595-( ) or SCR-695-( ) for recognition purposes has been installed (see paragraph 15.*r.* following). Provisions only are made on some airplanes for the installation of recognition radio set SCR-515.

b. COMMAND RADIO SET SCR-( )-183.

(1) GENERAL.—Radio set SCR-( )-183 is a short-range, multichannel aircraft radio receiving and transmitting equipment consisting of a receiver, a transmitter, a dynamotor, coil units, antenna switching relay, antenna, and radio remote control boxes. Power for this radio equipment is obtained by connection through a 50-ampere fuse and the radio interference filter to the left-hand tunnel positive bus.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Do not change tubes or make adjustments inside any unit of the equipment with the dynamotor running.

(2) DESCRIPTION.

(a) RECEIVER BC-( )-229. *(3, figure 474.)*—The receiver for the command radio set is shock-mounted on the outboard side of the upper radio shelf in the radio operator's compartment. An opening in the side of the receiver is for coil unit C-270 or coil set C-266. Coil set C-266, installed in the receiver, has a frequency range of 2500 to 4700 kilocycles; the spare coil unit C-270, mounted either forward of the radio operator's compartment to the right of the walkway or on the aft bulkhead of the radio operator's compartment, is a dual coil having two frequency bands: a high-frequency band of 4150 to 7700 kilocycles and low-frequency band of 201 to 398 kilocycles. When the dual coil is used, the high- or low-frequency band is selected remotely

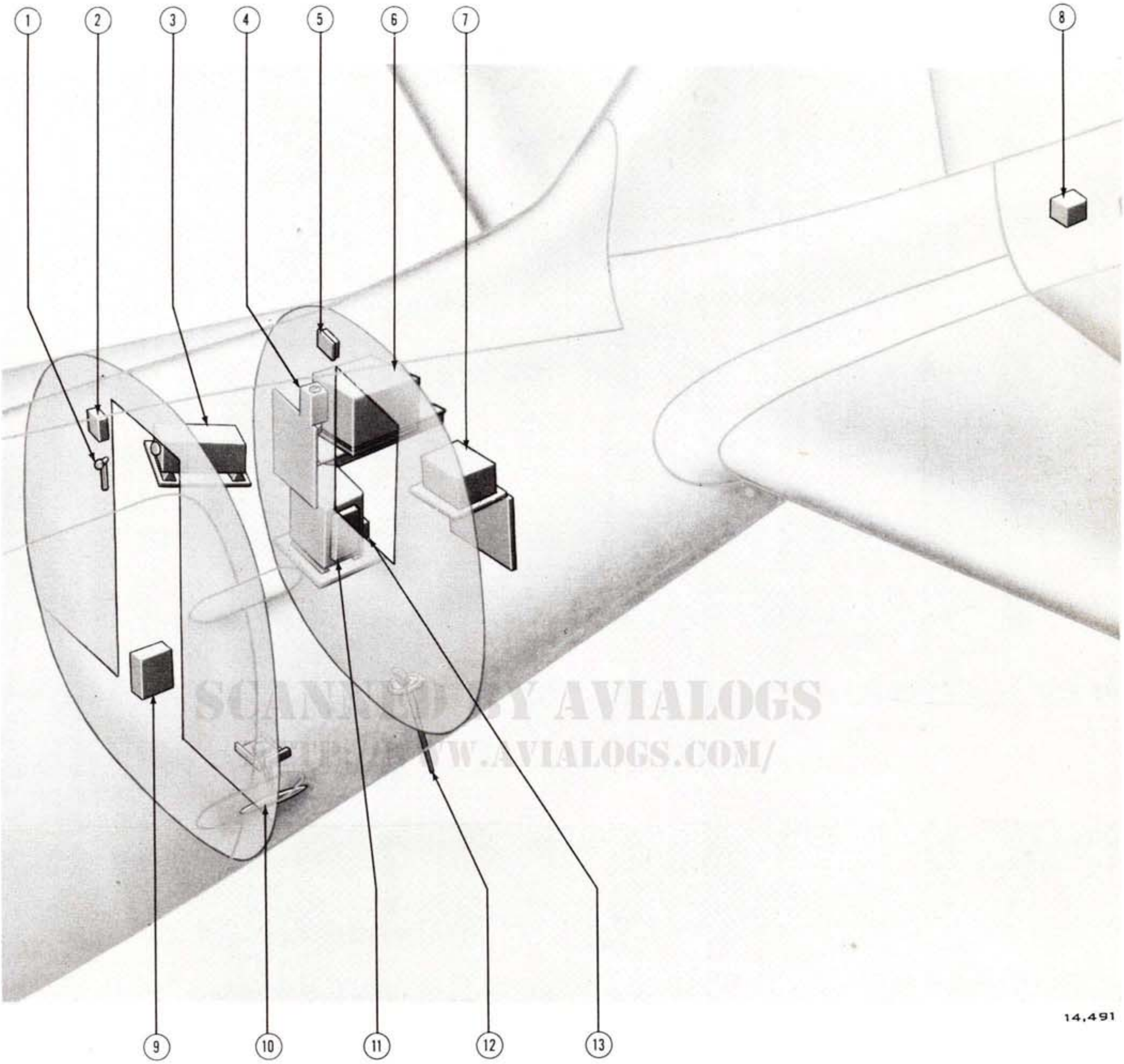


Figure 473—Communications System (Sheet 3 of 3 Sheets)

1. Main Cargo Compartment Microphone
2. Main Cargo Compartment Interphone Jack Box
3. *AN/APN-1 Radio Altimeter Transmitter-Receiver Unit
4. IFF Radio Inertia Switch Box
5. Carbon Microphone Adapter
6. SCR-522-( ) Command Transmitter-Receiver Unit
7. SCR-522-( ) Command Radio Dynamotor
8. Glider Interphone Disconnect
9. SCR-578-( ) Emergency Life Raft Transmitting Equipment (on Inside of Main Cargo Door)
10. *AN/APN-1 Radio Altimeter Antenna
11. IFF (SCR-595-( ) or 695-( )) Radio Receiver
12. IFF Radio Antenna
13. IFF Indicator Lamp Box

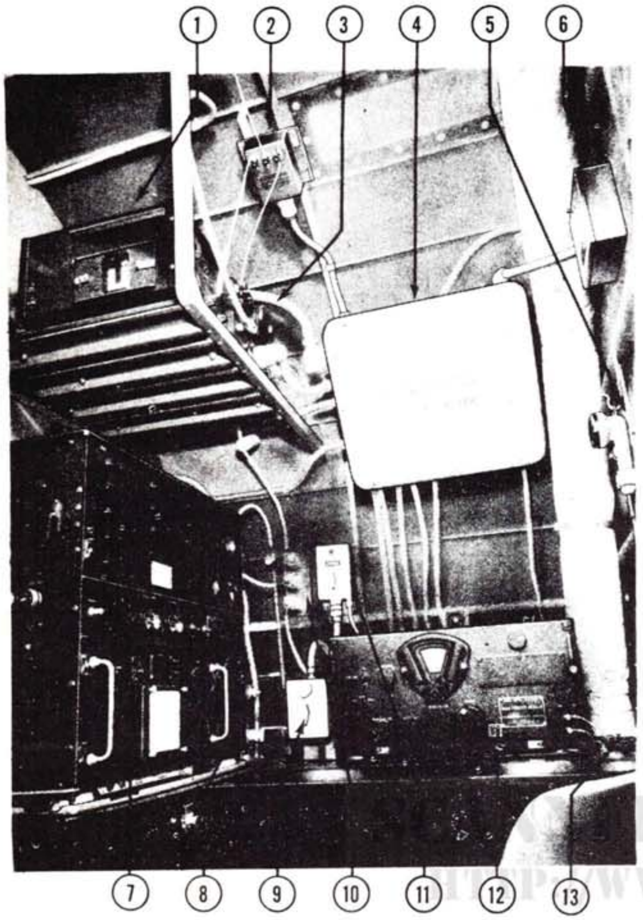


Figure 474—Radio Operator's Compartment, Upper Portion (C-47)

1. Command Transmitter
2. Command Antenna Switching Relay
3. Command Receiver
4. Liaison and Command Junction Box
5. Radio Operator's Microphone
6. Interphone Amplifier
7. Liaison Transmitter
8. Marker Beacon Receiver
9. Radio Operator's Interphone Jack Box
10. Liaison Antenna Changeover Switch
11. Liaison Trailing Antenna Reel Control Box
12. Liaison Receiver
13. Radio Operator's "C-W" Key

from the pilot's compartment by means of the "HI-LO" band switch control mounted on the bulkhead behind the copilot's seat and connected to the dual coil unit. The frequency of the receiver coil is tuned by operation of the remote tuning unit MC-125 (7, figure 443), mounted in the pilot's compartment beneath the right-hand electrical control panel. On the face of the receiver is the antenna binding post, the ground binding post, the tuning dial and control outlets, the antenna input alignment control knob, and the power plug receptacle. Also on the face of some receivers are the loop antenna receptacle, antenna selector switch, and a closed circuit jack, none of which are used on this installation. On the top of the receiver is a cover for

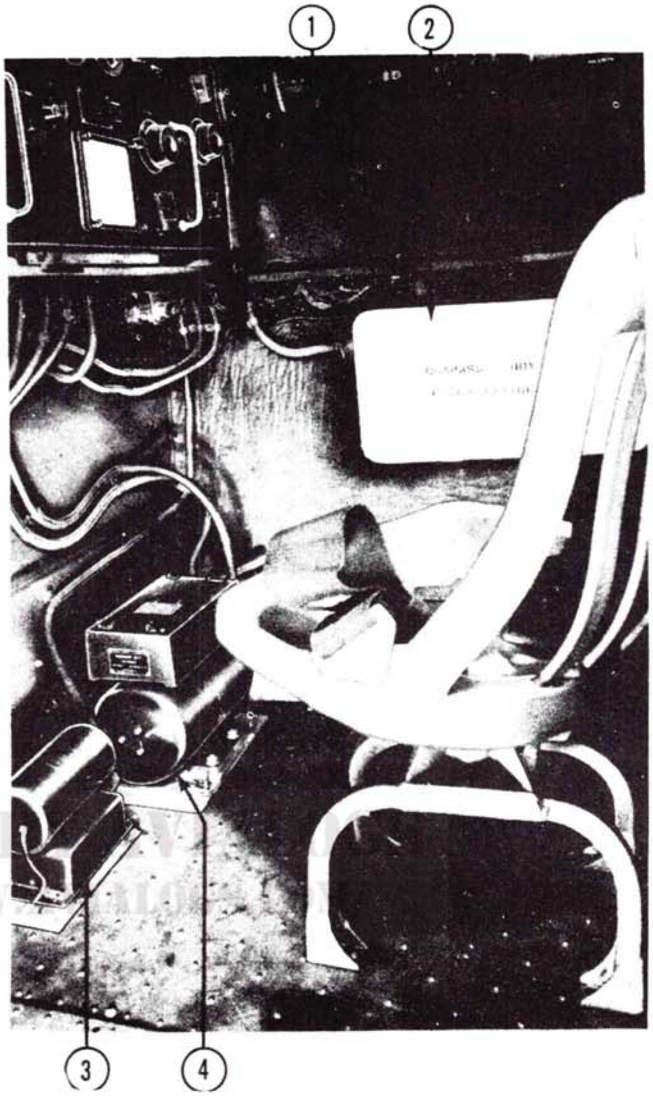


Figure 475—Radio Operator's Compartment, Lower Portion (C-47)

1. Liaison Transmitter
2. Compass Junction Box
3. Command Radio Dynamotor
4. Liaison Radio Dynamotor

the tube compartment on which is a calibration char intended as a general guide in locating stations on the receiver dial.

(b) RECEIVER CONTROL BOX BC-( )-231. *(1, figure 443.)*—The remote control box for the command receiver is mounted on the ceiling of the pilot's compartment, above the pilot's seat. This control box has two manually operated controls; a selector switch and a volume control ("INCREASE OUTPUT") knob. The selector switch has three positions: "AUTO," "OFF," and "MANUAL." The receiver control box is also provided with two telephone jacks, a power plug receptacle, and mounting snap slides.

(c) TRANSMITTER BC-( )-230. *(1, figure 474.)*—The transmitter for the command radio set is shock-

mounted on the inboard side of the upper radio shelf in the radio operator's compartment. An opening in the side of the transmitter is for one of the six coil sets provided. Coil set C-184, installed in the transmitter, has a frequency range of 4000 to 5000 kilocycles; five spare coil sets are installed either forward of the radio operator's compartment to the right of the walkway or on the ceiling of the radio operator's compartment and cover the following frequency ranges: C-271, 2500-3200 kc; C-272, 3200-4000 kc; C-273, 4000-5000 kc; C-274, 5000-6200 kc; and C-275, 6200-7700 kc. Mounted on each coil set is a plate showing the calibration for that coil. The frequency of the transmitter coil is tuned by operation of the "FREQENCY CONTROL" knob and calibrated dial, on the face of the transmitter. On the face of the transmitter is the "ANTENNA TUNING" knob, the antenna current ammeter, the antenna and ground binding posts, and locking knobs for the frequency and the antenna tuning controls. On top of the transmitter is a cover for the tube compartment. On the left side of the transmitter are two jacks and a small aperture cover. The bottom jack is a closed-circuit jack by which the amplifier current may be measured while the top jack is used when measuring the modulator-oscillator current. The aperture cover may be removed to adjust the compensating condenser.

(d) TRANSMITTER CONTROL BOX BC-( )-232. *(6, figure 443).*—The remote control box for the command transmitter is mounted on the ceiling of the pilot's compartment, above the copilot's seat. This control box has a manually operated control; the emission selector switch. This switch has three positions: "VOICE," "CW," and "TONE." When one of the positions is selected, the appropriate circuit in the transmitter operates to allow the desired type of emission. The transmitter control box is provided with a telegraph key and adjusting screw to adjust the spacing between the key contacts, a microphone jack, and a key jack connected in parallel with the telegraph key.

(e) DYNAMOTOR UNIT BD-( )-83. *(3, figure 475.)*—The dynamotor unit for the command radio set is mounted on the floor of the radio operator's compartment beneath the forward radio shelf. The dynamotor is mounted on a box containing condensers and resistors necessary to make up a radio-frequency disturbance filter circuit and a voltage divider, and is connected by a single plug to the liaison and command junction box.

(f) ANTENNA SWITCHING RELAY BC-( )-198. *(2, figure 474.)*—The antenna switching relay for the command radio set is mounted on the outboard wall of the radio operator's compartment, above the liaison and command junction box. Two binding posts are provided for connection to the antenna terminals of the command receiver ("REC") and transmitter ("TR").

(g) ANTENNA. *(12, figure 473, sheet 2.)*—The antenna used by both the command receiver and transmitter is attached to the "ANT" binding post of the antenna switching relay and is strung from the upper left antenna mast to the vertical stabilizer.

(h) JUNCTION BOX. *(4, figure 474.)* – The junction box used by both the liaison and command radio sets is installed on the outboard wall of the radio operator's compartment, above the liaison receiver. The junction box is used as an interconnecting element for all the circuits in the command set and contains the fuses, resistor, capacitor, and keying relay necessary for command radio operation. In the bottom of the junction box is the monitor switch used in the liaison radio set circuit to interconnect the transmitter and receiver ("MONITOR" position) during transmitter operation or to disconnect the receiver during transmitter operation ("NORMAL" position).

(3) REMOVAL.

(a) RECEIVER.

1. Disconnect remote tuning shaft.

2. Disconnect power plug.

3. Disconnect dual coil remote switch shaft (if installed).

4. Disconnect ground and antenna terminals.

5. Release snap slides and remove receiver from mounting.

(b) TRANSMITTER.

1. Disconnect power plug.

2. Disconnect ground and antenna terminals.

3. Release snap slides and remove transmitter from mounting.

(c) RECEIVER REMOTE CONTROL BOX.
TRANSMITTER REMOTE CONTROL BOX.
DYNAMOTOR.

1. Disconnect power plug.

2. Release snap slides and remove from mounting.

(d) ANTENNA SWITCHING RELAY.

1. Disconnect power plug.

2. Disconnect the three antenna terminals.

3. Release snap slides and remove relay from mounting.

(4) INSTALLATION.—Reverse procedure as described in paragraph (3), removal, preceding.

(5) MAINTENANCE AND ADJUSTMENTS.—Refer to section X on service inspections for communications equipment.

c. LIAISON RADIO SET SCR-187-A.

(1) GENERAL.—Radio set SCR-187-A is a long-range, multichannel aircraft radio set consisting of a receiver and dynamotor, a transmitter, a transmitter dynamotor, an antenna tuning unit, tuning units, antennas, remote transmitter control switch, and "CW"

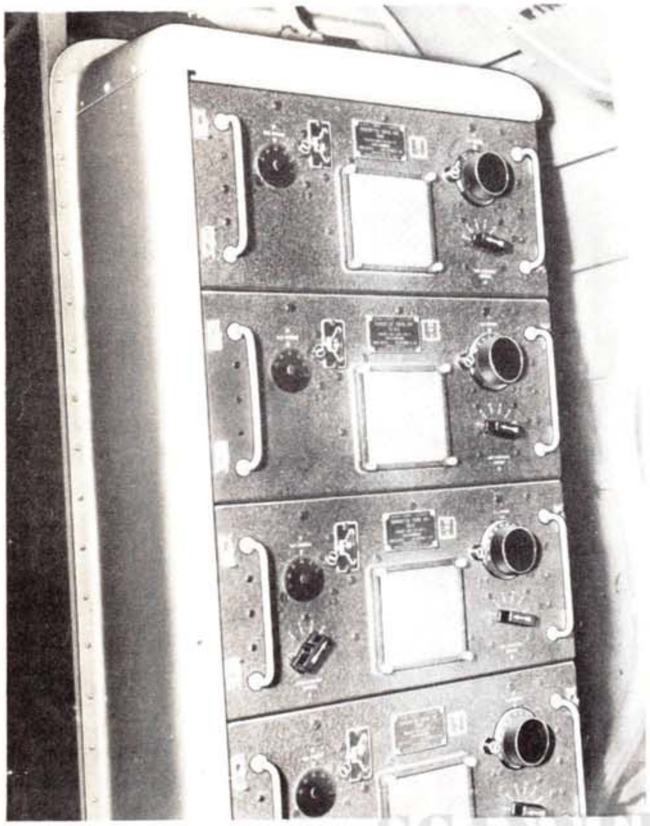


Figure 476—Liaison Transmitter Tuning Units

key. Power for the liaison set is obtained by connection to the left-hand tunnel positive bus through the compass junction box.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life.

(a) Do no change tubes or make adjustments inside equipment with high voltage supply on.

(b) Do not complete or maintain any connection between radio transmitter and dynamotor unit unless all duplicate unused sockets on the radio transmitter are covered by socket caps with catches properly snapped in place.

(c) Under no circumstances should any person be permitted to operate the dynamotor unit with the fuse box cover or end bells removed; to replace fuses with power on; or to remove, place, or handle removed plugs with the dynamotor unit running.

(d) Under no circumstances, adjust circuits or service the equipment when only the key is OFF. The radio transmitter uses a grid-bias keying circuit which does not remove high voltage when the key is open.

(2) DESCRIPTION.

(a) RECEIVER BC-224-( ). *(12, figure 474.)*—The receiver for the liaison radio set is shock-mounted on the radio shelf in the radio operator's compartment. On the face of the receiver are the following controls: The "BAND SWITCH" control selects the desired frequency band as shown on the dial mask. There are six bands with varying frequency ranges, depending upon the particular type of receiver BC-224-( ) installed.

The "TUNING" control varies the setting on the selected frequency band. The "DIAL LIGHTS" control turns on and varies the intensity of the two lamps for dial illumination. The "ANT. ALIGN." control aligns the input circuit to the antenna. The "CRYSTAL OUT-IN" switch permits the insertion of an IF crystal filter when extreme selectivity is desired. The "C.W. OSC. ON-OFF" switch controls the operation of the "CW" oscillator as well as the "AVC" time constant for "CW" reception. The "AVC-OFF-MVC" switch turns on the receiver power in automatic or manual volume control position. The "INCREASE VOLUME" control is for sensitivity adjustment on "MVC" operation and for output level adjustment on "AVC" operation. The "BEAT FREQ" control permits adjustment of the "CW" oscillator frequency. The zero beat position of this control is shown by the arrow on the knob pointing up. The antenna binding post ("A") and the ground binding post ("G") are below the "ANT. ALIGN." knob. There are also two open circuit telephone jacks providing connections to the headset. A cut-out, covered by a plate, is provided below the "DIAL LIGHTS" control to give access to the wiring under the RF tube shelf for servicing and maintenance. Dynamotor DM-24-( ) for receiver BC-224-( ) is mounted in the receiver case and is easily removable without disturbing other parts. This dynamotor supplies all of the high voltage required for the operation of the receiver. The plug for the power connection to the receiver is at the bottom rear section of the receiver mounting.

(b) TRANSMITTER BC-191-( ). *(7, figure 474.)*—The transmitter for the liaison radio set is shock-mounted on the forward radio shelf in the radio operator's compartment. A space in the bottom section of the transmitter case is provided for one of the various tuning units. Transmitter tuning unit TU-8-( ), installed in the transmitter, has a frequency range of 6200 to 7700 kilocycles. The following spare tuning units, installed forward of the radio operator's compartment to the right of the walkway and on the bulkhead aft of the forward entrance door (figure 476), have the following frequency ranges: TU-5-( ) 1500-3000 kc, TU-6-( ) 3000-4500 kc, TU-7-( ) 4500-6200 kc, TU-9-( ) 7700-10,000 kc, TU-10-( ) 10,000-12,500 kc, and TU-26-( ) 200-500 kc. TU-26-( ) is not installed on all airplanes. On the face of the tuning unit are the following controls: master oscillator tuning control and lock, frequency control knob, power amplifier tuning control and lock, antenna coupling selector switch, and band change switch (supplied and used only when tuning controls do not cover the complete frequency range of the tuning unit). In the center is a calibration chart which gives the proper settings for the transmit-

ter controls when that particular tuning unit is used. The neutralizing capacitor adjusting control is installed beneath the calibration chart. The upper front section of the transmitter case is a removable shield covering the tube compartment. On the rear wall of the tube compartment are the input level control, the speech amplifier bias control, the side tone control, the modulator bias control, the 12- to 14.2-volt selector switch, the ac-dc selector switch, and two small knob adjustment wrenches. The controls are used in transmitter adjustment. The 12- to 14.2-volt selector switch is to be in the "14.2V" position for transmitter operation on the airplane generators or external power supply, and in the "12V" position for operation on the airplane batteries or external batteries. The ac-dc selector switch is always to be in the "DC" position on this installation. The right-hand side of the transmitter case contains the antenna tuning equipment to be used at any frequency between 800 to 12,500 kilocycles (on airplanes equipped with tuning unit TU-26-( ), antenna tuning unit BC-306-A is provided). This equipment has the following components: antenna current ammeter, antenna inductance tuning control, antenna circuit selector switch, antenna capacitance tuning control and lock, and the antenna inductance selector switch. On the face of the transmitter, above the tuning unit, are the following: the total plate current ammeter, the filament voltmeter, the emission type selector switch, the "ON-OFF" switch, the filament voltmeter selector switch, the pilot lamp, and the test key. The emission type selector switch has three positions: "TONE," "CW," and "VOICE." The filament voltmeter selector switch has two positions: "CW FIL." and "MOD. FIL." The "ON-OFF" switch applies power from the dynamotor to the transmitter. The pilot lamp lights when power is applied to the transmitter. On the left side of the transmitter case are the sockets for plugs PL-59 and PL-61 from the dynamotor, the socket for plug PL-74 (not used on this installation), the socket for plug PL-64 from the liaison and command junction box, and the microphone and key jacks. On the right side of the transmitter case is the output terminal board containing binding posts for the following: receiver, ground, counterpoise, "A" loading, "B" loading, and antenna. Since a ground system is used on this installation, the "CPSE" and "GND" posts are linked together. The "LOAD A" and "LOAD B" posts are linked together, except when the tuning unit TU-26-B and the antenna tuning unit BC-306-A are used. The "REC" binding post is for connection to the liaison receiver antenna to provide for interconnection of the receiver and transmitter when the monitor switch at the bottom of the liaison and command junction box is in the "MONITOR" position. When the monitor switch is in the "NORMAL" position, the receiver and transmitter are not connected. A remote "ON-OFF" switch for the transmitter is located on the copilot's radio junction box (5, figure 495), in back of the copilot's seat. This switch performs the same function as the "ON-OFF" switch on the face of the transmitter.

(c) ANTENNA TUNING UNIT BC-306-A. *(13, figure 497.)*—On some airplanes only, the antenna tuning unit is mounted in the radio operator's compartment below the forward radio shelf. On the face of the unit are two controls: the antenna variometer selector switch and the antenna variometer control and lock. On the top of the unit are the transmitter ("A-TRANS"), the antenna ("B-ANT"), and the ground ("GND") binding posts. The antenna tuning unit is used with the liaison transmitter when tuning unit TU-26-B is installed only. For operation on frequencies above 400 kilocycles, the binding posts "A-TRANS." and "B-ANT" on the antenna tuning unit are connected to the "LOAD A" and "LOAD B" binding posts, respectively, on the transmitter. For operation on frequencies below 400 kilocycles, a jumper is placed across the "LOAD A" and "LOAD B" binding posts on the transmitter, binding post "A-TRANS" on the antenna tuning unit is connected to the "ANT" binding post on the transmitter, and the liaison antenna is connected to the "B-ANT" binding post on the antenna tuning unit. The ground post ("GND"), of the antenna tuning unit, should always be connected to the transmitter ground ("GND").

(d) DYNAMOTOR UNIT BD-77-( ). *(4, figure 475.)*—The dynamotor unit for the liaison radio set transmitting equipment is mounted on the floor of the radio operator's compartment, beneath the forward radio shelf. Mounted on the top of the dynamotor is the relay fuse box containing the various units necessary for the dynamotor operation. In one end of the relay fuse box are two sockets for the plugs PL-59 and PL-61 from the liaison transmitter. Between these two receptacles is a small hole for the entrance of the conduit from the compass junction box containing the two power input leads.

(e) ANTENNAS. *(22, figure 473, sheet 2.)*—The regular antenna for the liaison radio set is strung from the antenna mast above the radio operator's compartment to the mast on the vertical stabilizer. The trailing antenna, for added range on the liaison radio set, is wound on a reel mounted below the radio operator's compartment. The reel is driven by a small electric motor controlled by the reel control box, mounted on the outboard wall of the radio operator's compartment above the liaison receiver. On the reel-control box is a selector switch with three positions: "IN-OFF-OUT," a counter which records the feet of antenna extended, and a lamp which is connected into the landing-gear warning circuit, lights when the airplane is preparing to land, if the trailing antenna is extended. On the end of the trailing antenna wire is a weight to direct the travel when the antenna is extended. The antenna selector switch is mounted in the radio operator's compartment next to the trailing antenna reel control. The switch consists of a selector handle and three antenna connections. The regular antenna is connected to the upper terminal, the trailing antenna to the lower terminal, and the liaison

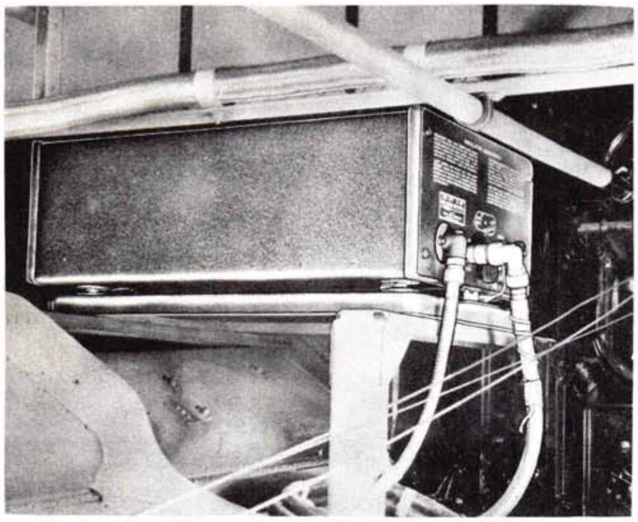


Figure 477—Radio Compass Receiver Unit Installed (C-47)

transmitter "ANT" binding post to the center terminal. The liaison receiver "ANT" binding post is connected to the liaison transmitter "REC" binding post. With the selector switch in the upper position, the regular antenna is connected to the liaison set; with the switch in the lower position, the trailing antenna is connected to the liaison set.

CAUTION

When a three-bladed propeller is carried as loose equipment in the lower section of the forward fuselage, the trailing antenna must not be used.

(f) CW KEY J-37. *(13, figure 474.)*—The radio operator's transmitting key is located on the radio shelf aft of the liaison receiver.

(3) REMOVAL.

(a) RECEIVER.

1. Disconnect the plug at the back of the receiver.

2. Disconnect the antenna and ground terminals.

3. Release the snap slides and pull the receiver from the mounting.

(b) TRANSMITTER.

1. Disconnect all the plugs on the left side of the transmitter.

2. Disconnect all wires at the terminal panel on the right side of the transmitter.

3. Release the snap slides and pull the transmitter from the mounting.

(c) ANTENNA TUNING UNIT.

1. Disconnect the three terminals on the top of the unit.

2. Release snap slides and pull unit from mounting.

(d) DYNAMOTOR.

1. Disconnect the two plugs.

2. Disconnect the input leads at the binding posts.

3. Release snap slides and remove dynamotor unit from mounting.

(4) INSTALLATION.—Reverse procedure as described in paragraph (3), removal, preceding.

(5) MAINTENANCE AND ADJUSTMENTS.—Refer to section X on service inspections for communications equipment.

d. RADIO COMPASS SCR-280-A (on some airplanes only).

(1) GENERAL.—Radio compass SCR-280-A is a receiving equipment capable of providing: *(a)* visual, unidirectional, right-left indication of the arrival of radio frequency energy with respect to the plane of the loop and simultaneous "ON COURSE" aural reception of modulated radio frequency energy; *(b)* aural reception of modulated radio frequency energy, using a nondirectional antenna; *(c)* aural reception of modulated radio frequency energy, using a loop antenna; and, *(d)* aural-null directional indications of the arrival of modulated radio frequency energy with respect to the plane of the loop, using a loop antenna. The set consists of a receiver and dynamotor, a remote control box, a loop antenna, a nondirectional antenna, a bearing indicator, and a compass left-right indicator. Power for this radio equipment is obtained by connection to the left-hand tunnel positive bus.

(2) DESCRIPTION.

(a) RADIO COMPASS UNIT BC-431-( ). *(See figure 477.)*—The radio compass receiver unit is shock-mounted beneath the floor of the left-hand baggage compartment. The unit includes mounting FT-213-A, dynamotor DM-20-A, and receiver equipment. On the face of the unit are the following: a "RELEASE" knob which releases the unit from the mounting; an access hole, through which the "LOOP GAIN" and "THRES SENS" adjustment controls may be reached; a socket for the power plug connections; a socket for the loop antenna plug connection; the non-directional antenna binding post; the ground binding post, and the tuning drive connection.

(b) RADIO CONTROL BOX BC-432-( ). *(3, figure 443.)*—The radio compass remote control box is mounted in the pilot's compartment, between the two electrical panels and above the ignition switch. The control box contains the following: a 200- to 1750-kilocycle frequency dial calibrated in three bands; a band change switch; a tuning crank; a function switch with four positions: "COMP.," "ANT.," "LOOP," and "OFF"; an "AUDIO" control, which regulates the

level of audio signal in the headset; a "COMPASS" control which regulates the compass left-right indicator sensitivity; a tuning meter to show, by maximum deflection of the pointer to the right, when the radio compass unit is tuned exactly to the station; a "CONTROL" switch (not used); and a "LIGHTS" control which regulates the intensity of the lamps. A lamp is provided for the tuning dial, the tuning meter, and one for a green indicator lamp (not used). Two spare lamps are installed below the tuning meter. The "COMP." position of the function switch is used for radio compass homing or direction finding; the "ANT." position is used for radio compass receiver operation with the nondirectional antenna; the "LOOP" position is used for radio compass receiver operation with the directional loop antenna.

(c) BEARING INDICATOR I-75-( ). *(8, figure 443.)*—The radio compass bearing indicator is mounted above the instrument panel, below the magnetic compass. The indicator is graduated in one degree intervals and indicates the angular position of the loop antenna. The position of the indicator pointer and the loop antenna is controlled by control unit MC-204 (9, figure 443), attached below the right windshield and connected to the bearing indicator and loop antenna by flexible shafts. At the bottom right of the bearing indicator is the "E-W VAR" knob which is used to compensate the indicator for East or West magnetic variation.

(d) LEFT-RIGHT COMPASS INDICATOR I-65-( ).—The left-right compass indicator is installed on the lower left-hand side of the instrument panel (15, figure 308). The center of the indicator dial is marked with a small figure of an airplane. The indicator pointer moves to show whether the airplane is "ON COURSE," or to the left or right of the radio station.

(e) ANTENNA LOOP LP-19-( ). *(35, figure 473, sheet 2.)*—The antenna loop assembly is a loop-wrapped antenna enclosed in a zeppelin-type housing and mounted, extending downward, directly below the passageway between the radio operator's and the left-hand baggage compartments. The loop is electrically connected to the radio compass receiver and is connected to the bearing indicator by means of a flexible shaft. Both the loop antenna and the bearing indicator are manually controlled by operation of control unit MC-204, mounted below the right-hand windshield.

(f) NONDIRECTIONAL ANTENNA. *(Figure 473, sheet 2.)*—The antenna loop assembly is a loop-to the "ANT." binding post of the radio compass receiver and extends from the under side of the fuselage to the aft pitot-static tube and to the belly mast.

(3) REMOVAL.

(a) RADIO COMPASS UNIT.

1. Remove the screws holding the center floor panel in the left-hand baggage compartment and remove the panel, exposing the radio compass receiver unit.

2. Disconnect the power plug, the tuning shaft connection and the loop antenna plug.

3. Disconnect the antenna and ground binding posts.

4. Release the snap slides at the bottom of the unit and lift the receiver unit from its mounting.

(b) RADIO CONTROL BOX.

1. The control box panel may be removed from its mounting by unscrewing the three captive screws around the edge of the box and then unscrewing the plug release screw located in the lower right-hand corner (next to the tuning control).

2. Disconnect the tuning shaft.

3. The mounting may be removed from the fuselage by removing the four attaching screws.

(c) BEARING INDICATOR.

1. Disconnect the flexible shaft.

2. Remove the screws attaching the indicator to the bracket and remove the indicator.

(d) LEFT-RIGHT INDICATOR.

1. Disconnect the screws attaching indicator to panel.

2. From the fuselage nose access door, disconnect the electrical plug and remove indicator.

(e) LOOP ANTENNA.

1. Remove the floor in the companionway between the radio operator's and left-hand baggage compartments in order to obtain access to the loop mounting.

2. Disconnect the electrical plug and the tuning shaft from the loop base.

3. While one man is holding on to the loop antenna from the outside, a second man must remove the screws attaching the loop to the fuselage skin. The first man may then remove the loop.

(f) NONDIRECTIONAL ANTENNA. — Disconnect the antenna at the lead-in insulator, at the pitot tube, and at the belly mast.

(4) INSTALLATION.—Reverse procedure as described in paragraph (3), removal, preceding.

(5) MAINTENANCE AND ADJUSTMENT.—Refer to section X on service inspections for communications equipment.

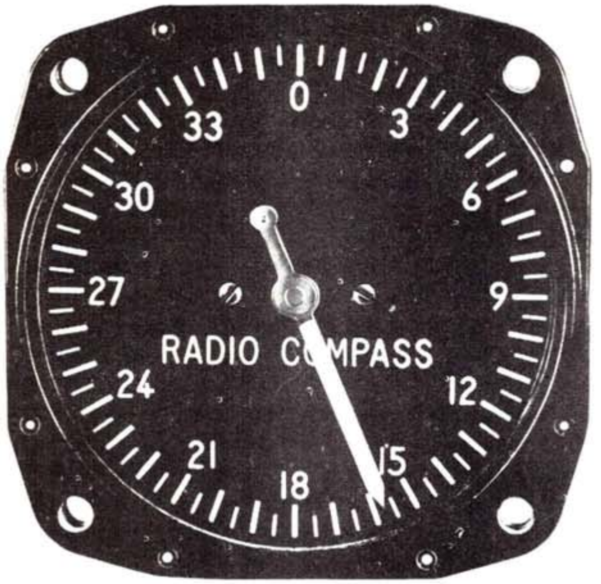


Figure 477A—Radio Compass Bearing Indicator I-81-( )

e. RADIO COMPASS SCR-269-G (on some airplanes only).

(1) GENERAL.—Radio compass SCR-269-G is navigational equipment consisting of a radio receiver, a remote control box, a bearing indicator (figures 477a, 1, 477b and 25, figure 309), a loop antenna, and a nondirectional antenna. The frequency range of the equipment is 200 to 1750 kilocycles, covered in three bands. The radio compass installation is capable of providing: *(a)* automatic bearing indication of the direction of arrival of radio frequency energy and simultaneous aural reception of modulated radio frequency energy; *(b)* aural reception of modulated radio frequency energy using the nondirectional (vertical) antenna; *(c)* aural reception of modulated radio frequency energy using the loop antenna; *(d)* aural-null directional indications of the arrival of modulated radio frequency energy using the loop antenna; and, *(e)* aural reception of unmodulated radio frequency energy in each of the four cases listed above. The 115-volt, 400-cycle power supply is furnished by the inverter in the right-hand baggage compartment.

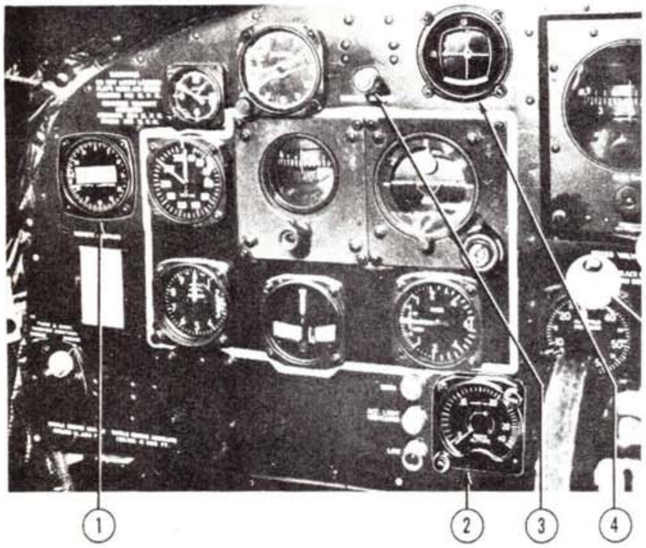


Figure 477B—Radio Equipment—L.H. Instrument Panel

1. Radio Compass Bearing Indicator I-81-( )
2. Power Switch Knob for Double Range Indicator *ID-14/APN-1
3. Indicator Lamp 39B2823-4
4. Glide Path Indicator

(2) DESCRIPTION.

(a) RADIO COMPASS UNIT BC-433-( ). *(40, figure 473, sheet 2.)*—The radio compass receiver unit is shock-mounted in a box on the aft floor of the navigator's compartment (under the center floor of the navigator's compartment, on some airplanes). The unit includes mounting FT-213-( ) and the necessary elements and circuits for operation as a receiver and compass. On the face of the unit are the following: a "RELEASE" switch which releases the unit from the mounting; an access hole, through which the "AUTO SENS" and "THRES SENS" adjustment controls may be reached; a socket for the power plug; a socket for the loop antenna plug; the "CW-VOICE" switch and binding post; the nondirectional antenna binding post; the "GROUND" binding post; the "SHIELD" binding post; and the tuning drive connection.

(b) RADIO CONTROL BOX BC-434-( ). *(2, figure 496.)*—The radio compass remote control box is mounted in the pilot's compartment, between the two electrical panels and above the ignition switch. The control box contains the following: a frequency dial calibrated in three bands; a band change switch; a tuning crank; a function switch with four positions: "COMP," "ANT," "LOOP," and "OFF"; an "AUDIO" control, which regulates the level of the audio signal in the headset; a "LOOP L-R" switch, which controls rotation of the loop; a tuning meter, to show, by maximum deflection of the pointer to the right, when the radio compass unit is tuned exactly to the station; and a "CONTROL" switch, which is not used in these airplanes. A lamp is provided for the tuning dial and the tuning meter. The green indicator lamp is not used. Two spare lamps are installed below the tuning meter. The "COMP" position of the function switch is used for radio compass homing or direction finding, the "ANT." position is used for radio compass receiver operation with the nondirectional antenna, the "LOOP" position is used for radio compass receiver operation with the directional loop antenna.

(c) BEARING INDICATOR I-81-( ). — The radio compass bearing indicator is installed on the left-hand side of the instrument panel, (25, figure 309). The indicator is an autosyn-driven device which indicates the angular position of the loop and thereby gives the bearing of a radio station when the loop is at its true null. Its scale is graduated every 5 degrees.

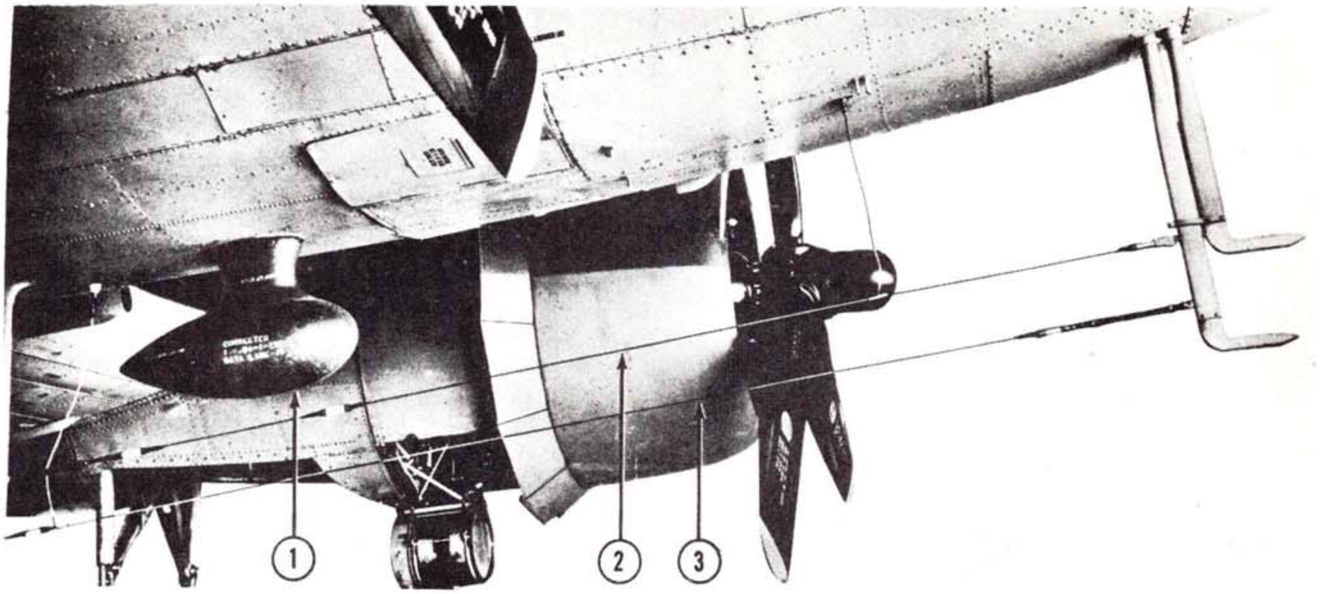


Figure 477C—Forward Antennas for Most C-47B Airplanes

1. Antenna Loop LP-21-( )
2. Marker Beacon Antenna
3. Radio Compass Nondirectional Antenna (ARN-7)

(d) ANTENNA LOOP LP-21-( ). *(35, figure 473, sheet 2 of 3 sheets: 1, figure 477C, and 477D.)*—The antenna loop assembly is a rotatory mounted, motor-driven antenna loop enclosed in a zeppelin-type housing, with a motor, compensator, and autosyn transmitter located in the base. Included with the loop is a dehydrator unit Bendix AC57763-1 (figure 477e), which serves to maintain the interior of the loop assembly free from moisture. The dehydrator is a glass column, containing silica gel impregnated with cobalt chloride, mounted under the forward radio shelf in the radio operator's compartment. All air entering or leaving the interior of the loop assembly passes through the dehydrator unit; the contents of the unit are a blue color when the desiccant is dry, and lavendar or pink when it requires reactivation. The unit is connected to the loop assembly by fittings and a rubber hose.

(e) NONDIRECTIONAL ANTENNA ARN-7. *(28, figure 473, sheet 2, and figure 477C.)*—The nondirectional antenna is connected to the "ANT." binding post of the radio compass receiver and extends from the underside of the fuselage to the aft pitot static tube and to the belly mast.

(f) INVERTER. *(3, figure 493.)*—One type inverter unit PE-109, is installed on the lower shelf of the right-hand baggage compartment. The inverter unit consists of a control box mounted on a single phase alternator which is driven by a direct current motor on the same shaft. The inverter provides the 115-volt, 400-cycle power necessary to radio compass SCR-269-G operation. The inverter is turned "ON" by the operation of the radio compass power switch through a relay in the compass junction box.

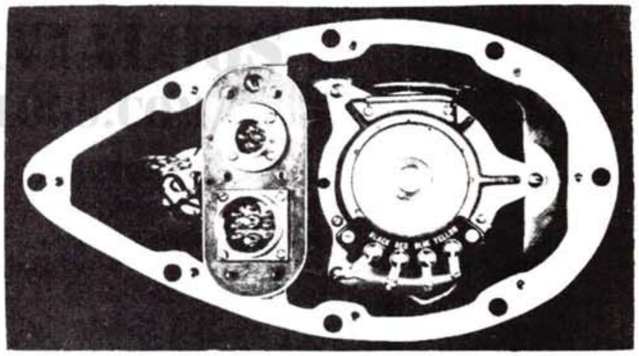


Figure 477D—Antenna Loop LP-21-( )

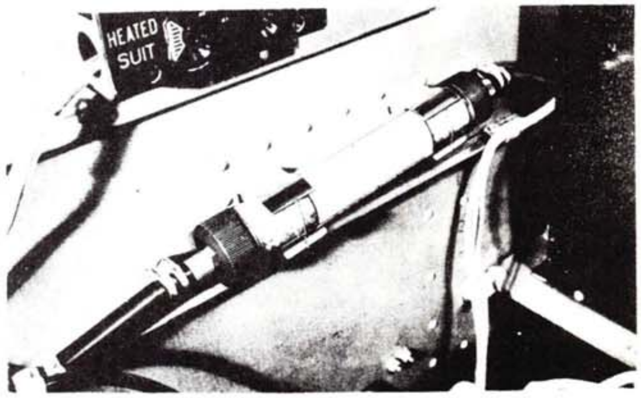


Figure 477E—Dehydrator Unit—Bendix AC57763-1

(3) REMOVAL.

(a) RADIO COMPASS UNIT.

Note

On airplanes in which the radio compass unit is installed below the navigator's floor, follow procedure as described in paragraph 15.*d.*(3) *(a),* this section.

1. Remove the cover of the guard box by removing the attaching screws.

2. Disconnect the power plug, the tuning shaft connection, and the loop antenna plug.

3. Disconnect the antenna, shield, and ground binding posts.

4. Release the snap slides at the bottom of the unit and lift the receiver unit from its mounting.

(b) RADIO CONTROL BOX.

1. Unscrew the three captive screws around the edge of the box. Unscrew the plug release screw located in the lower right-hand corner (next to the tuning control).

2. Disconnect the tuning shaft.

3. Lift the box panel from the mounting.

4. The mounting may be removed by removing the attaching screws.

(c) BEARING INDICATOR. – Same as described in paragraph 15.*d.*(3)*(d)* this section.

(d) LOOP ANTENNA.

1. Remove the floor in the companionway between the radio operator's and navigator's compartment in order to obtain access to the antenna loop connections.

2. Disconnect the electrical plugs and the dehydrator connection from the loop base.

3. From outside the airplane, remove the attaching screws and remove the loop assembly.

(e) NONDIRECTIONAL ANTENNA. – Disconnect the antenna at the lead-in insulator, at the pitot tube, and at the belly mast.

(f) INVERTER.–Disconnect electrical plug and remove snapslides holding inverter unit to mounting.

(4) INSTALLATION.–Reverse procedure as described in paragraph (3), removal, preceding.

(5) MAINTENANCE AND ADJUSTMENT. – Refer to section X on service inspections for communications equipment.

f. MARKER BEACON RECEIVING EQUIPMENT RC-39-( ).

(1) DESCRIPTION.–The marker beacon receiving equipment is a very high radio-frequency receiving set used as an aid to navigation and landing. The equipment consists of receiver BC-341-( ), indicator lamp 39B2823-4 (see figure 3, 477B), and an antenna (see figure 2, 477C). The receiver (8, figure 474) is mounted on the outboard side of the forward radio shelf in the radio operator's compartment. The indicator lamp is mounted on the upper left side of the instrument panel (1, figure 308), and uses a Mazda No. 1488 (or AN3121-1816) bulb. The antenna is strung from the receiver to the lower fuselage where it extends from the aft pitot static tube to the belly mast (above the radio compass nondirectional antenna). The frequency range of the receiver is approximately 67 to 80 megacycles. The equipment is designed to receive 75-megacycle marker beacon signals used in the army instrument landing system, cone of silence, and fan marker beacons of the C.A.A. and other facilities employing modulated 75-megacycle horizontally polarized transmissions. The indicator lamp gives a visual signal to the pilot when flying over a 75-megacycle marker beacon. When the receiver is over a "keyed" transmitter, such as a C.A.A. marker or certain types of army transmitters, the indicator lamp flashes in definite sequence, thereby identifying the transmitter.

(2) REMOVAL.

(a) RECEIVER.

1. Disconnect the electrical plug.

2. Disconnect the antenna.

3. Release the snapslides and lift the receiver from the mounting.

(b) LAMP.–The bulb may be replaced by unscrewing the lamp housing.

(c) ANTENNA. – Disconnect the antenna at the lead-in, the pitot tube, and at the belly mast.

(3) INSTALLATION.–Reverse procedure as described in paragraph (2), removal, preceding.

(4) MAINTENANCE AND ADJUSTMENTS. –Refer to section X on service inspections for communications equipment.

g. FREQUENCY METER SET SCR-211-( ).–The frequency meter set is a portable indicating equipment for frequency adjustments on receivers and transmitters and is installed on the aft wall of the navigator's (or left-hand baggage) compartment (6 figure 492). The frequency meter set consists of frequency meter BC-221-( ); headset P-18; crystal unit DC-9-D; and a calibration book. Also included in the set are the following spare parts; a set of the three needed tubes, a crystal unit DC-9-D, and a calibration book. Four batteries BA-23, six batteries BA-2, and another set of three tubes are boxed and shipped as spares in the airplane. The operating controls are located on the frequency meter panel and are as follows: a power switch, a microphone jack, a crystal oscillator switch, a two-position frequency band switch, the tuning control, and the output gain control. An antenna binding post is mounted on the top of the set. All power is provided by batteries, controlled by operation of the power "ON-OFF" switch. The frequency meter will be used and inspected as directed in section X on service inspections for communications equipment.

b. INTERPHONE EQUIPMENT RC-45.

(1) GENERAL.—Interphone equipment consists of an interphone jack box, a microphone, and a headset for each crew member; an interphone amplifier for the system; and two radio filter units, one each for pilot and copilot. The system receives its power by connection (of the interphone amplifier) to the command radio set dynamotor through a 15-ampere fuse in the liaison and command junction box. The interphone equipment is used for communication between the crew members and for operation of the various radio sets.

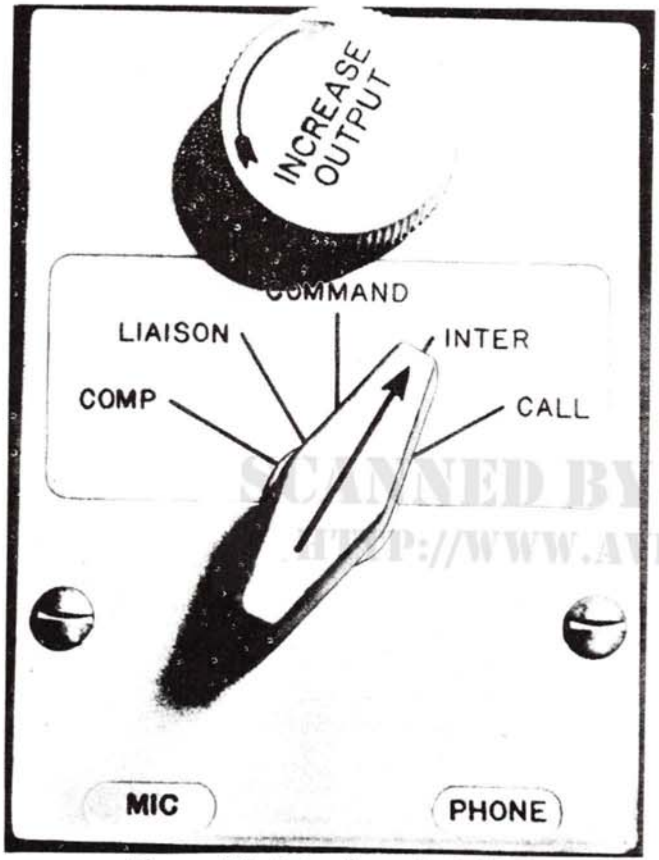


Figure 478—Interphone Jack Box

(2) DESCRIPTION.

(a) INTERPHONE JACK BOX. *(See figure 478.)*—One interphone jack box BC-366 is installed for each crew member: one to the left of the pilot's seat, and one to the right of the copilot's seat, one on the aft wall of the radio operator's compartment, one on the aft wall of the main cargo compartment, and one on the aft wall of the navigator's compartment (if installed). Each jack box has an "INCREASE OUTPUT" knob, a selector switch, a microphone jack, and a headset jack. The selector switch has the following positions for the following functions:

Note

On late C-47B airplanes a stop is installed on the jack box in the main cargo compartment which locks the selector switch to the "INTER" position. This plate is fastened by the two screws on the front of the jack box.

"COMP."

1. Output of radio compass heard in headset.

2. Limited control of headset volume with jack box volume control knob.

3. Microphone disconnected.

"LIAISON"

1. Output of liaison receiver heard in headset.

2. Limited control of headset volume with jack box volume control knob.

3. Modulation control of liaison transmitter with microphone switch closed.

"COMMAND"

1. Output of command receiver heard in headset.

2. Limited control of headset volume with jack box volume control knob.

3. Modulation control of command transmitter with microphone switch closed.

"INTER"

1. Communication will be possible with the other interphone stations whose jack box selector switches are in the "INTER" position.

2. Volume control is not effective.

"CALL"

1. Emergency call position on one box connects all jack boxes and headsets in parallel (no matter what position the selector switches of the other boxes are set in).

Note

The "CALL" position on the jack box control is spring-loaded and will return to the "INTER" position when not manually held.

2. Volume control is not effective.

(b) INTERPHONE AMPLIFIER. *(2, figure 497.)*—Interphone amplifier BC-212-( ) is installed on the aft wall of the radio operator's compartment. The input circuit is designed for the microphones; the output circuit to furnish power to the headsets. All external wiring is connected to a jack terminal strip mounted in the bottom of the amplified box. This plug-in chassis allows the amplifier assembly to be removed from the box without disturbing any soldered connections. It is only necessary to remove the screws which fasten the cover and lift straight up. The numbering of the terminals on the plug terminal strip corresponds to the numbering shown on the circuit label in the amplifier case.

(c) RADIO FILTER EQUIPMENT. — Filter equipment RC-32 consists of switch box BC-345 mounted one to the left of the pilot's seat and one to the right of the copilot's seat and radio filter FL-5-( ) installed aft of the pilot's seat and aft of the copilot's seat, each being controlled by the corresponding switch

box selector switch which has three positions: "RANGE," "VOICE," and "BOTH." "RANGE" reduces voice interference to range signal, "VOICE" reduces range interference to voice signal, "BOTH" is the normal position of the switch until it is desired to separate voice and range signals during a period of simultaneous reception. The filter equipment is not a part of the radio sets, but is merely introduced in series with the pilot's (and copilot's) headset and can be used with any receiver which is selected by the interphone jack box selector switch. The filter is connected to the jack box, therefore when a filter is used, the headset is plugged into the filter equipment, rather than the jack box.

(d) MICROPHONES.—One microphone T-17 is provided for each crew member, adjacent to each interphone jack box, and is used for voice modulation of the transmitters and interphone system. The microphone is connected by inserting the microphone plug into the jack of the extension cord which is connected to the interphone jack box (or radio filter switchbox). Each microphone is controlled by a push-to-talk switch on the side of the microphone.

(e) HEADSETS.—One headset HS-23 is provided for each crew member with an extension cord to permit freedom of movement.

(3) REMOVAL.

(a) INTERPHONE JACK BOX.

1. Remove the two screws which hold the cover to the body of the box.

2. Lift the cover straight out.

3. Disconnect the wires which are soldered to the plate inside the box. (The plate is roughly triangular shaped.)

4. Remove the three screws which fasten the plate to the bottom of the box and lift out the plate.

5. Lift out the Micarta sheet which has been placed beneath the plate to expose the two screws at one end which secure the box in place.

6. Remove these two screws and the third screw at the opposite end of the box and lift the box from the airplane.

(b) INTERPHONE AMPLIFIER.

1. Remove the two screws which fasten the cover assembly to the box and pull the cover straight out.

2. Remove the soldered wires.

3. Remove the four screws in the bottom of the box which fasten it to the airplane.

4. Remove the box from the airplane.

(c) RADIO FILTER UNIT.

1. Remove the two screws from the ears on both sides of the box.

2. At one end of the box is a plate which is fastened by four screws. The wires are connected at this plate, and to separate them from the box, either disconnect the wires or detach the end plate from the box.

3. Lift the box from the airplane.

(d) RADIO FILTER SWITCHBOX.

1. Remove the two screws which hold the cover to the body of the box.

2. Disconnect the wires.

3. Remove screws holding box to airplane.

4. Remove the box from the airplane.

(4) INSTALLATION.—Reverse procedure as described in paragraph (2) removal, preceding.

(5) MAINTENANCE AND ADJUSTMENTS.—Refer to section X on service inspections for communications equipment.

i. IDENTIFICATION RADIO SET SCR-595-( ) OR SCR-695-( ).

Note

Radio set SCR-595-( ) or SCR-695-( ) is covered in paragraph 15.*r.*, following.

j. RADIO SET SCR-515 (on some airplanes only.)—Provisions only are made for the installation of radio set SCR-515 consisting of the following: receiver-transmitter unit BC-645-( ), dynamotor and coder unit PE-101-( ), and indicator BC-727 which are to be mounted in the right-hand baggage compartment. Control box BC-646-( ) is to be mounted in the pilot's compartment, above the copilot's seat. Antenna mast AN-93 or R3090 is to be installed on the under side of the aft fuselage, below the tail cone compartment.

k. GENERAL (24-VOLT C-47A).—The radio sets installed on the C-47A airplane are as follows: command radio set SCR-274-( ) for communication from airplane to airplane or airplane to station in short range operation, liaison radio set SCR-287-( ) for communication from airplane to airplane or airplane to station in long range operation, radio compass SCR-269-G or *AN/ARN-7 for navigational purposes, marker beacon receiving equipment RC-43-( ) for navigation and landing, frequency meter set SCR-211-( ) for testing and adjustment of radio sets, interphone equipment RC-36 for crew member to crew member communication or crew member participation in the radio operations, and radio set SCR-595-A or SCR-695-A for recognition purposes. Provisions only are made for the installation of recognition radio set SCR-515. On some airplanes, the following sets are also installed: command radio set SCR-522-( ) for short range communication on very high frequencies, beacon radio set *AN/APN-2, radio receiving equipment *AN/ARR-1, and altimeter radio set *AN/APN-1. On some airplanes provisions only are made for installation of emergency radio set SCR-578-( ) and radio receiving equipment RC-103-( ).

l. COMMAND RADIO SET SCR-274-N.

(1) GENERAL.—Radio set SCR-274-N is a multichannel aircraft radio receiving and transmitting equipment consisting of three receivers and dynamotors, two transmitters, a modulator and dynamotor unit, an antenna relay unit, antenna, and the radio remote control boxes. Power for this radio equipment is obtained by connection to the bus in the left fuselage tunnel through the compass junction box.

WARNING

Dynamotor DM-33-A on the modulator unit of this radio set generates 600 volts d-c. This is sufficient to cause severe shock, or even death. Make absolutely certain that the dynamotor is not running before making any ad-

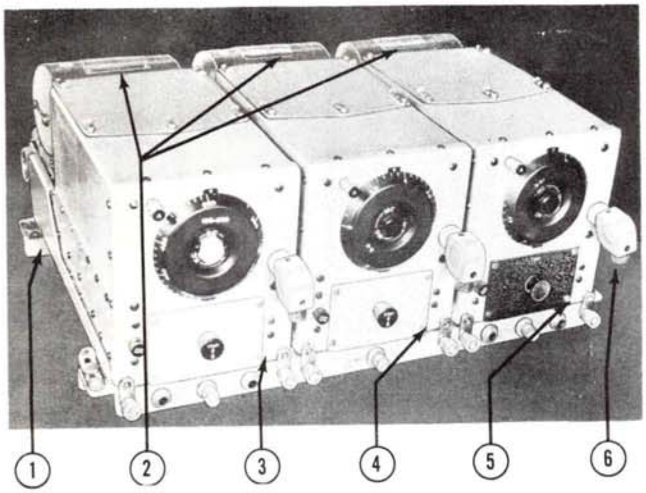


Figure 479—SCR-274-N Receivers—Front View

1. Rack FT-220-A
2. Dynamotors DM-32-A
3. Receiver BC-453-A
4. Receiver BC-454-A
5. Receiver BC-455-A
6. Coupling MC-211-A

justment whatever except tuning up the transmitters. In tuning up the antenna circuit of the transmitters, be careful to avoid touching the antenna when the power is on, or severe, irritating burns will result. Warn anyone who may be working near the antenna of your intentions to turn on the power.

FIRE.—If the radio set compartment has been exposed to gasoline vapor, make certain that it is aired out well before turning on the power. Dynamotor DM-32-A on each receiver, generates 250 volts d-c. The danger of exposure to this voltage must not be ignored. Make certain that all dynamotors are "OFF" before performing any adjustment to the equipment other than antenna alignment.

(2) RECEIVING EQUIPMENT.

(a) DESCRIPTION. — The receiving equipment consists of three receivers, three dynamotors, a receiver rack, a radio control box, antenna, and the necessary mountings, cords, and plugs.

1. RECEIVERS BC-454-( ), BC-453-( ) and BC-455-( ).—The three receivers (figures 478 and 479) covering the ranges of 3.0 to 6.0 megacycles, 190 to 550 kilocycles, and 6.0 to 9.1 megacycles, respectively, are mounted on a rack on the upper forward radio shelf in the radio operator's compartment, below the command set transmitters. The receivers are basically alike; each uses six metal 12-volt tubes, performing identical functions, and each may be operated in any of the three compartments of the rack although receiver BC-453-( ) should be installed in the center compartment of the rack to physically separate the other two receivers in order to reduce electrical interference between them. An antenna binding post is located on the upper left-hand corner of the front panel on each receiver. The tuning dial, which is controlled by a flexible shaft from the receiver control box, is located in the center of the front panel on each receiver. This flexible shaft plugs into the front of the receiver to the right of the tuning dial. An "INPUT ALIGN." control knob is located on the lower left-hand corner for the alignment of the antenna input.

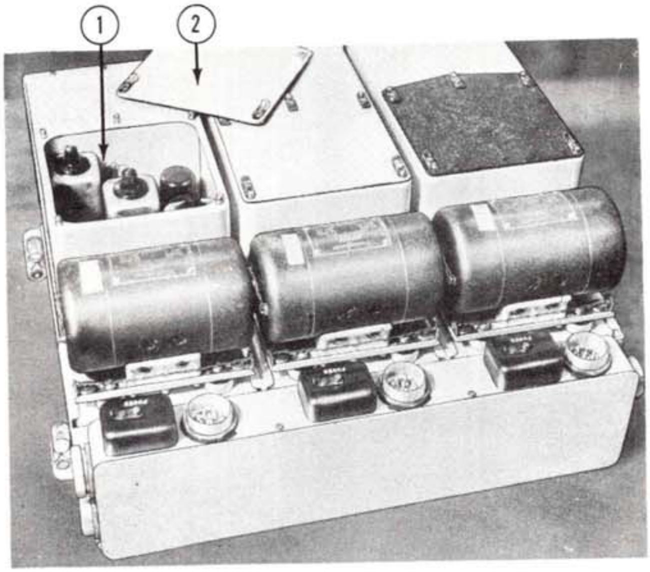


Figure 480—SCR-274-N Receivers—Rear View

1. Tube Compartment
2. Cover

2. DYNAMOTORS DM-32-( ).—A plug-in dynamotor (2, figure 479) which is held with snap-slides, is mounted on the back of each receiver. Each dynamotor furnishes power for the receiver upon which it is mounted, and is controlled by the "CW-OFF-MCW" switch on the radio control box.

3. RECEIVER RACK FT-220-( ).—The receiver rack (1, figure 479) fulfills three functions: It provides compartments into which the receivers are slid and locked in place; it provides an electrical junction box for essential interconnections; and it contains a receiver output-side-tone relay, an "A TEL-B TEL" toggle switch, a fuse, and three sets of "A TEL-B TEL" head set jacks.

Note

The "A TEL-B TEL" toggle switches in the center under the front of each receiver are covered by screw caps and are never operated when the receivers are remotely controlled.

4. RADIO CONTROL BOX BC-450-( ).—The receivers are remotely operated by the pilot through the radio control box (figure 481) mounted above and to the left of the pilot's seat. The radio control box is built in three similar sections to control the three re-

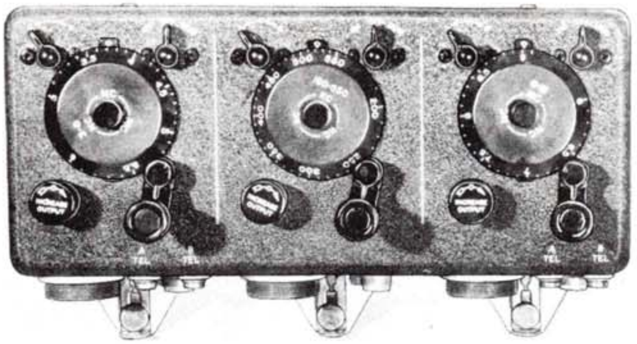


Figure 481—SCR-274-N Receiver Remote Control Unit

ceivers. Each section contains an "A-B" switch, "CW-OFF-MCW" switch, volume control ("INCREASE OUTPUT,") tuning knob, receptacles for the electrical and remote cables, and the outer two sections each contain two head set jacks ("A" and "B"). Each section of the control box is used to tune and control one receiver independently of the others. The "A-B" switches are provided for switching between the two phone jacks mounted on the bottom of the box; however, these jacks are not used on this installation. Signals can be tuned in on two or three receivers simultaneously by using the "INCREASE OUTPUT" controls to adjust the volume or to fade the signal from one receiver to another. In each group of controls, the "CW-OFF-MCW" switch performs the functions of a battery power switch and a heterodyne oscillator switch (for the reception of "CW" signals) in the receiver which is controlled by that particular group.

5. ANTENNA.—The antenna and relay unit, described in paragraphs 15.*l.*(3)*(a)6* and 7, following, are common to both the receiver and transmitter. The antenna is automatically switched by the relay from the receiver to the transmitter when the microphone press-to-talk button is depressed.

(b) REMOVAL.—Carefully read safety notice, paragraph 15.*l.*(1), this section, before handling this equipment.

1. RECEIVERS.

a. Disconnect the antenna from the "A" binding post.

b. Disconnect the tuning shaft cable from the insert.

c. Remove safety wires and unscrew knurled nuts in the rack in front of the transmitter far enough to unlock the receiver from the rack.

d. Slide the receiver from the rack (disconnecting it).

2. DYNAMOTORS.

a. Unlock dynamotor from receiver by sliding snap slides away from studs.

b. Disconnect dynamotor from receiver by lifting it straight up from receiver.

3. RECEIVER RACK.

a. Disconnect electrical plugs at the back and sides of rack.

b. Disconnect the ground wire connection at the "G" binding post.

c. Release snap slides and lift rack from mounting.

4. RADIO CONTROL BOX.

a. Disconnect the three electrical cables and the three tuning shafts from the bottom of the control box.

b. Slide the snap slides from the studs to release the control box from the mounting.

(c) INSTALLATION. — Reverse procedure as described in paragraph *(b)* removal, preceding, with the following precautions:

1. Carefully read safety notice, paragraph 15.*l.*(1), this section.

2. When attaching plugs, feel for the proper fit before applying any considerable pressure to the plugs. The locking rings must be hand-tightened.

3. Make certain the units are locked in place by the snap slides and safety wired.

(d) MAINTENANCE AND ADJUSTMENTS. —Refer to section X on service inspections for communications equipment.

(3) TRANSMITTING EQUIPMENT.

(a) DESCRIPTION.—The transmitting equipment consists of two transmitters, a modulator-dynamotor unit, radio control box, antenna relay unit, antenna, and the necessary racks, mountings, and cords.

1. TRANSMITTERS BC-457-( ) and BC-458-( ).—Two transmitters (figures 482 and 483) with ranges of 4.0 to 5.3 megacycles and 5.3 to 7.0 megacycles respectively, are mounted on the upper forward radio shelf, in the radio operator's compartment, above the command set receiver. Each transmitter contains a separate set of master-oscillator, RF-power-amplifier, and resonance indicator tubes and associated circuits, but each unit depends for its high-voltage dc and its modulating voltages on a common modulator and dynamotor, and for its entire remote control on a common radio control box. On the front panel of each transmitter, below the calibrated window, is located an "ANT. COUPLING" knob and lock which controls the amount of coupling of the antenna coupling coil. An "ANT. INDUCTANCE" knob and lock is located to the right of the calibrated window. This knob varies the inductance of the inductor in the antenna circuit and is the only antenna tuning control. An antenna binding post is located on the upper left-hand corner of each panel; the frequency control knob and lock is

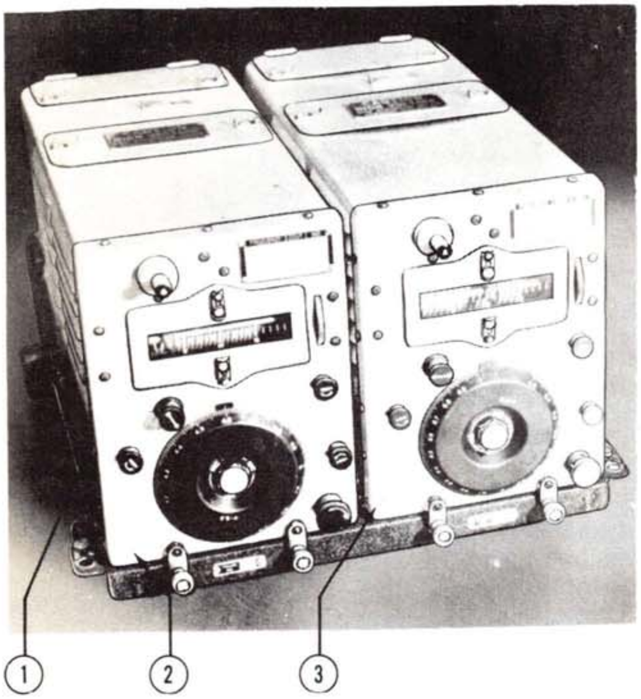


Figure 482—SCR-274-N Transmitters—Front View

1. Rack FT-226-A
2. Transmitter BC-457-A
3. Transmitter BC-458-A

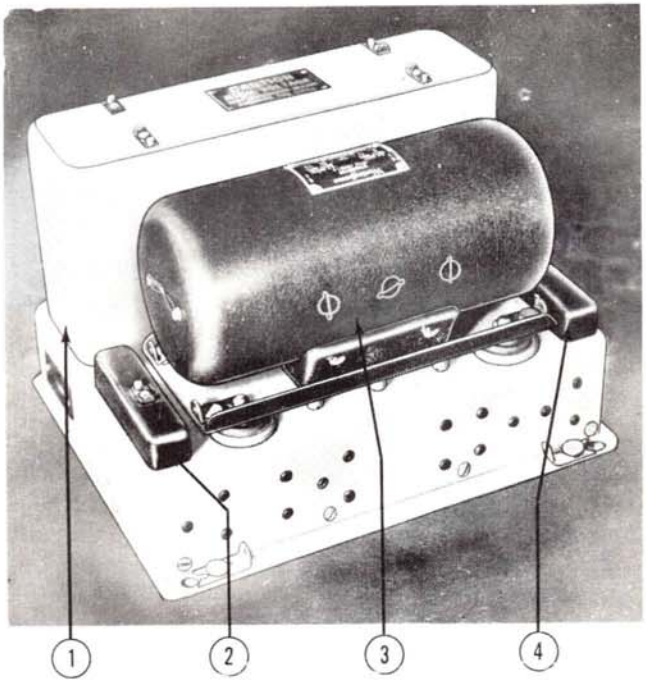


Figure 484—SCR-274-N Modulator and Dynamotor Unit—Front View

1. Modulator Unit BC-456-A
2. Fuse Cover
3. Dynamotor DM-33-A
4. Fuse Cover

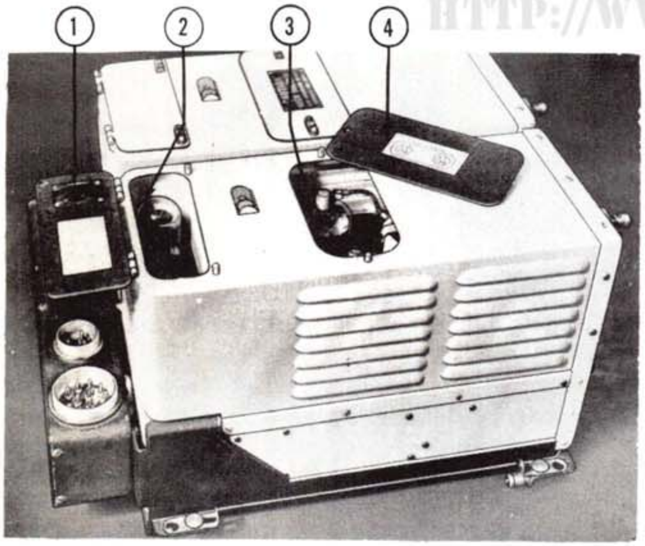


Figure 483—SCR-274-N Transmitters—Side View

1. Hinged Cover with Metallic Mirror
2. Tube and Crystal Compartment
3. Tube Compartment
4. Cover

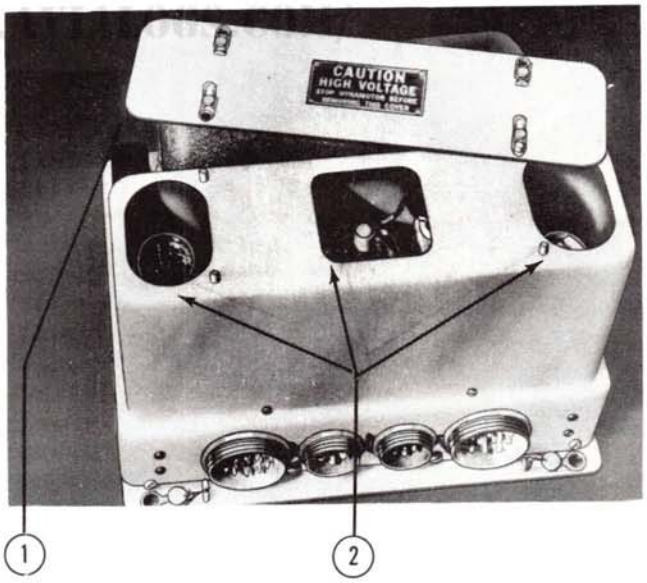
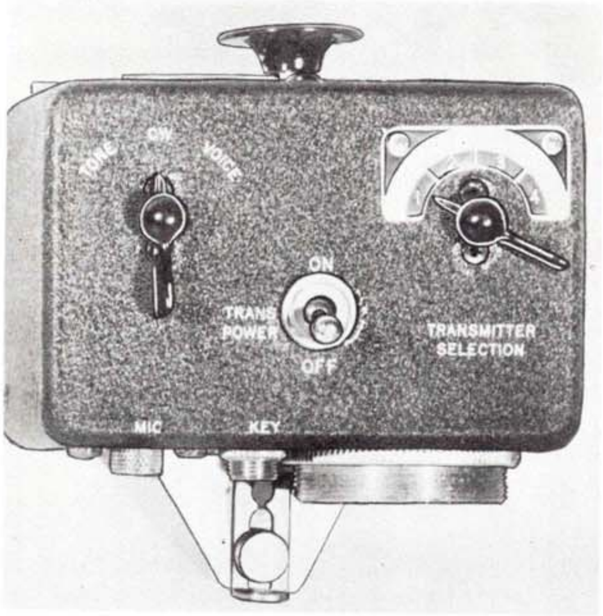


Figure 485—SCR-274-N Modulator and Dynamotor Unit—Rear View

1. Cover
2. Tube Compartment

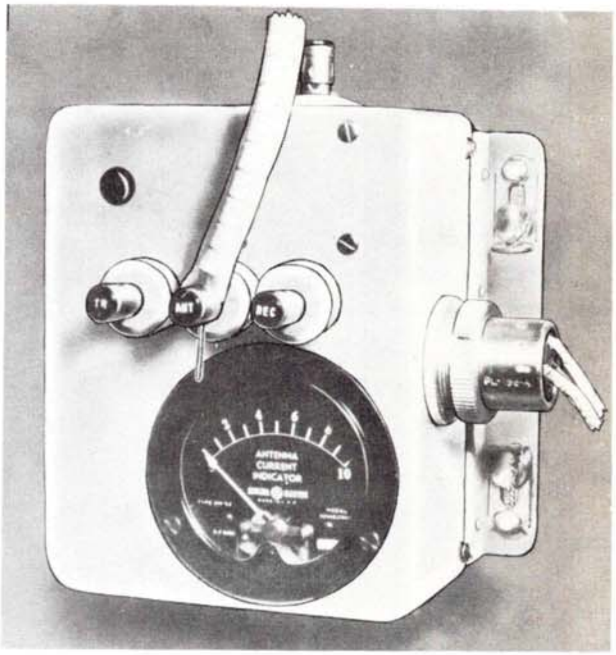
on the lower right-hand corner. On the side of the transmitting case are two snap caps, the small cap covering the hole to the shaft of the P.A. capacitor and the large cap covering the hole to the fine adjustment arm of the P.A. capacitor.

2. MODULATOR UNIT BC-456-( ).—The modulator and dynamotor (figures 484 and 485) are mounted in one unit which is installed on the outboard side of the upper shelf in the right-hand baggage compartment.



14,501

Figure 486—SCR-274-N Transmitter Remote Control Unit



14,502

Figure 487—SCR-274-N Antenna Relay Unit

3. DYNAMOTOR DM-33-( ). – The dynamotor is held with snap slides on a modulator unit and generates the high-voltage dc for the transmitting equipment.

4. TRANSMITTER RACK FT-226-( ). – Rack FT-226-( ) (1, figure 482), used for transmitter BC-457-( ) and BC-458-( ), contains two ground binding posts and circuits interconnecting the modulator unit with the transmitters and the antenna relay unit.

5. RADIO CONTROL BOX BC-451-( ).– The radio control box (figure 486) for remote control of the transmitting equipment is mounted on the upper left-hand side of the pilot's compartment, adjacent to the receiver control box. This box contains a three-position switch ("TONE-CW-VOICE") which controls the circuits determining the type of emission; a four-position switch which controls the circuits determining the choice of transmitter; a microphone jack; an external key jack; a built-in key; a toggle switch in the line from the power; and one receptacle for connection to the modulator unit. The microphone jack is constructed in such a manner that the sleeve may be grounded to the box, or not, by turning the protruding knurled nut by hand as far as it will go, counterclockwise or clockwise, respectively. In the counterclockwise position, the sleeve is grounded. The push-to-talk button on the microphone closes the microphone and relay circuits when the button is actuated. With the nut in the maximum clockwise position, the push-to-talk button may be locked closed, after which the pressing of the built-in key, external key, or throttle switch will perform the same functions that the push-to-talk button did when the knurled nut was in its full counterclockwise position. Although the "TRANSMITTER SELECTION" switch is a four-position switch designed to select one of four transmitters, only positions "1" and "2" are used in this installation.

Note

Under a snap cap on the top of the control box next to the built-in key is a two-position toggle switch which should always be in the "R-OUT" position.

6. ANTENNA RELAY UNIT BC-442-( ).– The antenna relay unit (figure 487) is fastened on the fuselage roof above the radio operator's seat. This unit contains an antenna current indicator, a receptacle for the cable leading to the transmitter rack, three binding posts which are for the transmitter, the receiver, and the antenna respectively, and a "LOCAL-REMOTE SWITCH" (on some installations). This switch should be left in the "LOCAL" position as the "REMOTE" position is not used in this installation.

7. ANTENNA.—The antenna (12, figure 473, sheet 2) which is used for the transmitters and receivers extends from a small mast extending from the top right of the fuselage above the radio operator's compartment to the vertical stabilizer (attached below the stabilizer mast). The antenna lead-in is wired through the mast to the antenna relay unit.

(b) REMOVAL.–Carefully read safety notice, paragraph 15.*l*.(1), this section, before handling this equipment.

1. TRANSMITTERS.

a. Disconnect the antenna from the "A" binding post.

b. Remove safety wires and unscrew knurled nuts in the rack in front of the transmitter far enough to unlock the transmitter from the rack.

c. Slide the transmitter from the rack (disconnecting it).

2. MODULATOR.

a. Disconnect the electrical cable from the front of the unit.

b. Release the snap slides and remove the modulator unit from the mount.

3. DYNAMOTOR.—Release snap slides and lift dynamotor from modulator unit (disconnecting it).

4. TRANSMITTER RACK.

a. Disconnect the electrical plugs at the back of the rack.

b. Disconnect the ground wire connection at the "G" binding post.

c. Release the snap slides and lift rack from mounting.

5. RADIO CONTROL BOX.

a. Disconnect the electrical cable from the bottom of the control box.

b. Release the snap slides at the bottom of the control box and lift box from mounting.

6. ANTENNA RELAY UNIT.

a. Disconnect the antenna leads and the electrical cable.

b. Release snap slides and remove unit from mount.

7. ANTENNA.

a. Disconnect the forward end of the antenna by removing the nut holding it to the lead-in.

b. Disconnect the aft end of the antenna by removing the bolt holding the shock spring to the stabilizer.

(c) INSTALLATION. — Reverse procedure as described in paragraph *(b),* removal, preceding, with the precautions listed in paragraph 15.*l.*(1), this section.

(d) MAINTENANCE AND ADJUSTMENTS. —Refer to section X on service inspection for communications equipment.

m. LIAISON RADIO SET SCR-287-A.

(1) GENERAL.—Liaison radio set SCR-287-A is essentially the same as liaison radio set SCR-187-A, described in paragraph 15.*c.* this section, except that the units are electrically different to permit the use of 28-volt power in the case of radio set SCR-287-A and the use of 15-volt power for radio set SCR-187-A.

(2) DESCRIPTION.

(a) RECEIVER BC-348-( ). *(15, figure 497.)*—This receiver is similar to the receiver described in paragraph 15.*c.*(2)*(a),* this section, with the following exception: Dynamotor DM-28-( ) is used in the receiver; and on some receivers BC-348-( ), different tubes are used.

(b) TRANSMITTER BC-375-( ). *(8, figure 497.)*—This transmitter is similar to the transmitter described in paragraph 15.*c.*(2)*(b),* this section, with the following exceptions: The selector switch on the rear wall of the tube compartment is a 24- to 28-volt switch; and tuning unit TU-26-( ) is supplied on all airplanes.

(c) ANTENNA TUNING UNIT BC-306-( ). *(13, figure 497.)*—This unit is the same as is described in paragraph 15.*c.*(2)*(c),* this section.

(d) DYNAMOTOR UNIT PE-73-( ). *(11, figure 497.)*—This dynamotor unit is similar to that described in paragraph 15.*c.*(2)*(d),* this section, except that the input voltage is 28 volts.

(e) ANTENNAS.—The antenna installation is similar to that described under paragraph 15.*c.*, this section.

(f) C-W KEY J-37. *(13, figure 474.)*—The radio operator's transmitting key is located on the radio shelf aft of the liaison receiver.

(3) REMOVAL.—Same as described in paragraph 15.*c.*(3), this section.

(4) INSTALLATION.—Reverse procedure as described in paragraph 15.*c.*(3), this section.

(5) MAINTENANCE AND ADJUSTMENTS.—Refer to section X on service inspections for communications equipment.

n. RADIO COMPASS.—There are two radio compass sets used on C-47A airplanes. The first set, the SCR-269-G is used in most of the C-47A airplanes. The second set, the AN/ARN-7, replaced the first in the late C-47A airplanes.

(1) RADIO COMPASS SCR-269-G.

(a) GENERAL.—This set is similar to the one described in paragraph 15.*e.*, this section, except that a 28-volt d-c supply is used and the inverter installation is changed to the following:

(b) DESCRIPTION.—One 750 volt-ampere inverter AAF 94-32770 (figure 493), is installed on the lower shelf in the right-hand baggage compartment (on some airplanes two 250 volt-ampere inverters are installed, selected by the inverter selector switch behind and above the co-pilot's seat). On some airplanes (on which the remote magnetic compass system is installed), the inverter is actuated by the C. H. 8201 inverter switch on the right-hand electrical panel through the type B-6 relay AAF 94-32352 on the inverter relay panel. The inverter switch is wired to power through a six ampere circuit breaker in the main electrical junction box. On the other airplanes, the inverter is actuated by the radio compass power switch or the flourescent lamps switch.

(c) REMOVAL.—Disconnect electrical plug and

remove snapslides (or bolts) holding inverter unit to mount.

(d) INSTALLATION. – Attach inverter to mount with snapslides (or bolts). Connect electrical plug.

(e) MAINTENANCE AND ADJUSTMENT.– Refer to Section X on Service Inspection for Communication Equipment.

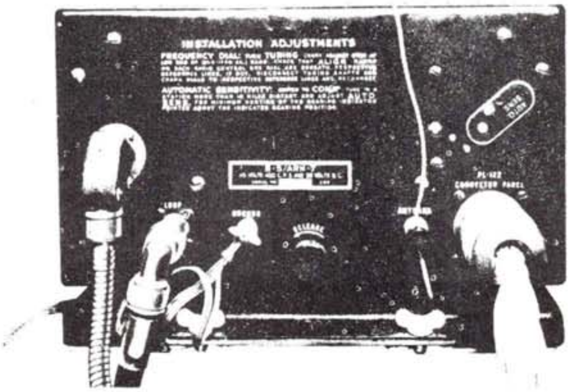


*Figure 487A—Radio Compass Unit *R-5/ARN-7*

Note

On some airplanes a "C.W. ON-OFF" switch for the radio compass operation is installed in the pilots' compartment, above the right-hand electrical panel (7, figure 459) for use when the receiving equipment *AN/ARR-1 is used.

(2) RADIO COMPASS *AN/ARN-7.

(a) GENERAL.—This set is similar to the one described in paragraph 15.*e.,* this section with the exception of the following:

(b) DESCRIPTION.

1. RADIO COMPASS UNIT *R-5/ARN-7. *(See figure 487a.)*—The frequency range of the equipment is 100 to 1750 kilocycles covered in four bands. The 15 tube radio compass receiver unit is shock-mounted in a box on the aft floor of the navigator's compartment. On the face of the receiver are the following: a "RELEASE" switch which releases the unit from the mounting; an access hole, through which the "AUTO. SENS." adjustment controls may be reached; a socket for the power plug; a socket for the loop antenna plug; the non-directional antenna binding post; the "GROUND" binding post; and the tuning drive connection.

2. RADIO CONTROL BOX *C-4/ARN-7. *(See 2, figure 496.)* (See paragraph 15.*e.*(1)*(b)* this section.) The "C.W.-VOICE" switch is located on the side of the box.

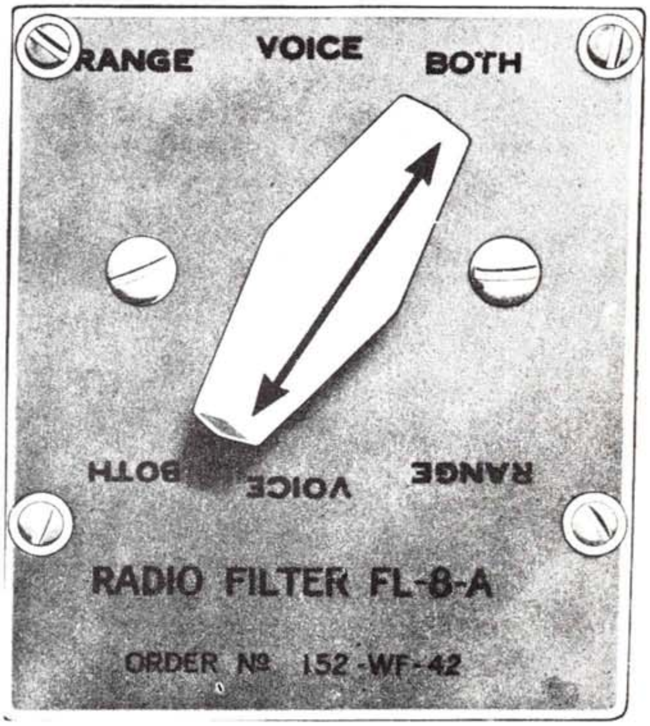


Figure 488—Filter Unit (C-47A)

3. INVERTER. *(See figure 493.)*—One type AAF 94-32770-A 750 volt-ampere inverter is installed on the lower shelf of the right-hand baggage compartment. The inverter provides the 115-volt, 400 cycle power necessary to radio compass *AN/ARN-7 operation and also supplies a-c power for the fluorescent lighting in the pilots' compartment by connection through the auxiliary lamp box. The inverter is turned "ON" by the switch mounted on the right-hand electrical panel.

o. MARKER BEACON RECEIVING EQUIPMENT RC-43-( ).—The marker beacon receiving equipment installation is similar to that described in paragraph 15.*f.,* this section, with the following exception: the input voltage is 24 volts; receiver BC-357-( ) or BC-1033-( ) (12, figure 497) is used; and the indicator lamps use a 42B-3593-2 bulb. On early airplanes an AN3121-313 bulb is used.

p. FREQUENCY METER SET SCR-211-( ).—The frequency meter installation is similar to that described in paragraph 15.*g.,* this section.

q. INTERPHONE EQUIPMENT RC-36.—The interphone equipment installation is similar to that described in paragraph 15.*h.,* this section, with the following exceptions: The system receives its power from dynamotor PE-86-( ) (see following); interphone amplifier BC-347-( ) is used; filter equipment RC-198 consisting of radio filter FL-8-( ), which includes the filter and switchbox in one unit, is used; on some airplanes low-impedence headsets HS-33 are provided and adapters MC-385-( ) are plugged into the filters and jack boxes; on some airplanes, a glider and a capacitor (mounted on the aft wall of the lavatory compartment) is wired between the glider disconnect and the amplifier to cut down the interference to the glider jack box caused by the two line connection. The following information is given for dynamotor PE-86-( ):

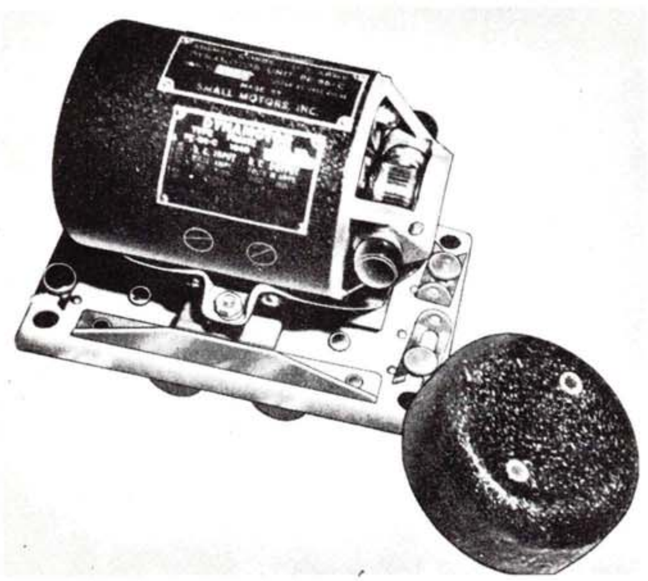


Figure 489—Interphone Dynamotor (C-47A)

(1) DESCRIPTION.—Dynamotor PE-86-( ) (figure 489) for interphone equipment RC-36 is mounted on the inboard side of the upper radio shelf, next to the command set receivers, and is used to convert the 24-volt supply from the airplane electrical system to the higher voltage required by the interphone system. The dynamotor is connected through the interphone amplifier and is "ON" when the airplane electrical system is "ON."

(2) REMOVAL.

(a) Release the snap slides and lift the dynamotor from its mount.

(b) Disconnect the electrical wires and remove dynamotor.

(c) To remove the dynamotor box, extract the screws in the bottom of the box which fasten it to the airplane.

(3) INSTALLATION.—Reverse procedure as described in paragraph (2), removal, preceding.

(4) MAINTENANCE AND ADJUSTMENT.—Refer to section X on service inspections for communications equipment.

r. IDENTIFICATION RADIO SET SCR-595-( ) OR SCR-695-( ).

(1) GENERAL.—Radio set SCR-595-( ) or SCR-695-( ) consists of a receiver, control equipment, an emergency destructor circuit, and an antenna. Because of its confidential status, information, other than that following or in the service inspections on communications equipment in section X of this handbook, must be obtained from the handbook of maintenance instructions for the set.

Note

Remember this radio set is equipped with a destructor. The destructor plug PL-177 must be removed and stowed at all times except when the plane is about to take off or is engaged in actual flight operation. The plug must never be inserted in the destructor jack (in the receiver) until it has been determined that there is no voltage at the plug by connecting a test lamp or a buzzer across the plug terminals.

(2) RECEIVER.

(a) DESCRIPTION.—Receiver C-( )-46AAQ (or BC-966-A) is installed on a chock mounting on the right-hand side of the tail cone compartment. On the face of the receiver are the following receptacles: "ANT." for the antenna plug; "SUP." for the suppressor cable (not used on this installation); the destructor unit receptacle for the plug PL-177 from the detonator circuit; and two receptacles for the plugs from the power control box and selector control box.

(b) REMOVAL.

1. Remove the destructor plug from the receiver and hang on the plug holder mounted adjacent to the radio shelf.

2. Take out the destructor unit.

CAUTION

THIS UNIT IS EXPLOSIVE. OBSERVE ALL SERVICE REGULATIONS FOR THE HANDLING AND TEMPORARY STORAGE OF SUCH MATERIAL.

3. Disconnect all bonding jumpers and release the plug hold-down wire. Pull off all plugs.

4. Remove the tie wire from the two knurled clamping collars on the front edge of the receiver unit shock mounting and unscrew them for about half an inch until they can be disengaged from the hold-down lugs on the front of the receiver cabinet. The collars can then be allowed to drop downward out of the way.

5. Pull the receiver unit an inch or so toward the front edge of the shock mounting. This disengages the tapered hold-down plungers at the rear. Either draw the receiver forward or lift clear from the mounting.

(c) MAINTENANCE AND ADJUSTMENT.—Refer to section X on service inspections for communications equipment. Replace a defective receiver as follows:

1. Place the receiver on the shock mounting and slide it toward the back until the two tapered hold-down plungers engage the holes in the angle members at the rear of the mounting.

2. Clamp the receiver unit by raising the two knurled clamping collars and screwing them over the front hold-down lugs on the receiver. Next, thread a piece of No. 16 AWG steel tie-wire (0.051-inch diameter) through one of the four holes in each clamping collar, draw it tight, and twist each end around the wire as though making a splice. Use fresh wire, if

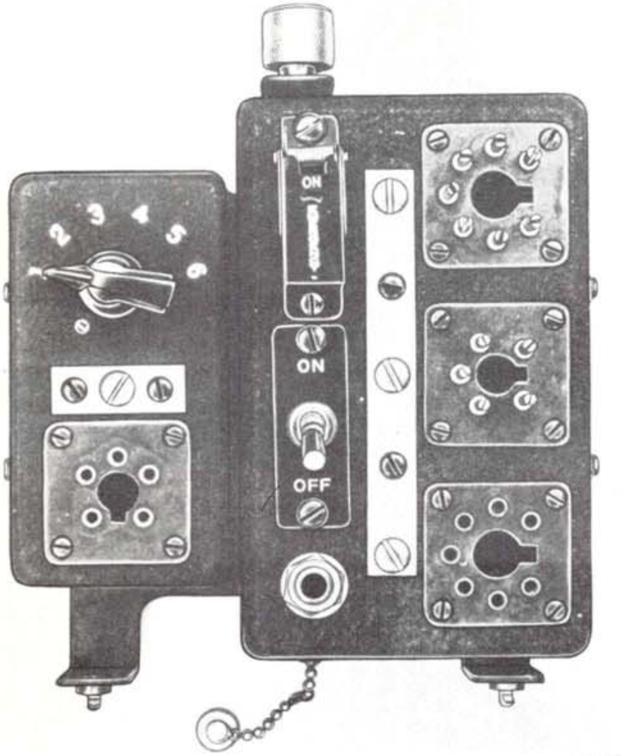


Figure 490—SCR-595-( ) or 695-( )
Control Box Unit

available, since a wire that has already been spliced several times is more likely to break during flight and allow vibration to loosen the clamping collars.

3. Restore destructor unit to its socket. Leave the destructor plug on its holder.

CAUTION

THIS UNIT IS EXPLOSIVE.

4. Put back all other plugs and reconnect all bonding jumpers.

(3) CONTROL BOX UNIT. *(See figure 490.)*

(a) DESCRIPTION. – Control equipment RC-255-A is located on the outboard wall of the radio operator's compartment and consists of selector control box BC-965-A and power control box BC-958-A. The selector control box has a dial, a pointer, and receptacle for the plug from the receiver. The power control box has an "ON-OFF" switch, an "EMERGENCY" switch, a capped phone jack, and receptacles for the power plug from the battery, the plug from the pilot's switches, and the two plugs from the receiver. The power socket for the power plug is mounted forward of the power control box. There is also an "ON-OFF" switch and a guarded "EMERGENCY" switch in the pilot's compartment above and behind the pilot's seat (figure 494).

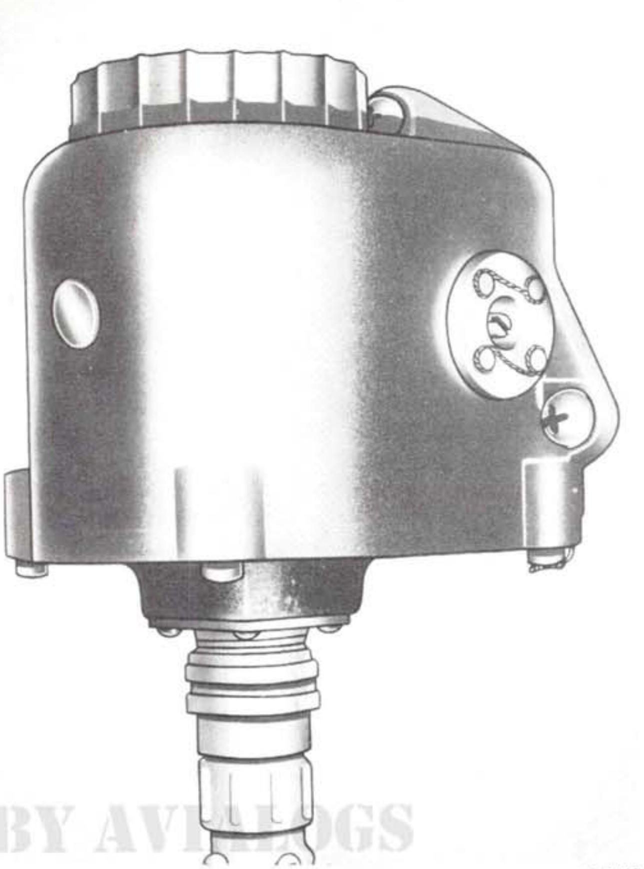


Figure 491—SCR-595-( ) or 695-( )
Inertia Switch Box

Note

Radio set SCR-695-( ) is similar to radio set SCR-595-( ) except that it contains "G" band provisions, but they are not used in these airplanes.

(b) REMOVAL.– Power control box BC-958-A and selector control box BC-965-A are ordinarily handled as a single unit because both are screwed to the one mounting.

1. Disconnect all four cable bonding jumpers at the panels and pull out the plugs. Be sure that the battery cable assembly is disconnected first.

2. Loosen the knurled clamping nut by unscrewing it.

3. Pull control unit forward and lift out of mounting bracket. This combined pulling and lifting motion will disengage the two mounting lugs on the bottom of the securing plate from the slots in the mounting bracket.

4. Power control box BC-958-A can be taken off the securing plate by removing the three machine screws on the back. Selector control box BC-965-A can be taken off in a similar manner by removing the two screws.

(c) MAINTENANCE AND ADJUSTMENTS.—Refer to paragraph 15.*r*.(2)*(c)*, this section. Replace a defective control box unit as follows:

1. Unscrew knurled clamping nut at the top of the mounting and insert two lugs at the bottom into the corresponding slots in the mounting bracket. Gently push the assembly back into the mounting bracket, guiding the screw carrying the clamping nut at the top into the slot.

2. Check to see that both bottom lugs engage the slots properly; if they do, tighten the knurled clamping nut.

3. Put back all four plugs and reconnect all bonding jumpers. Put the battery cable assembly back last.

(4) DESTRUCTOR CIRCUIT.

(a) DESCRIPTION. — The destructor circuit consists of the following units: The destructor unit is located in the receiver and is connected to the destructor circuit by a plug. Indicator box BC-767 is mounted aft of the receiver in the tail cone compartment and consists of two red lamps inertia-switch box BC-706-A or switching assembly *SA-3/A is mounted in the tail cone compartment above the receiver and consists of a pendulum-set impact switch. Destructor switch box BC-765 is mounted in the pilot's compartment above and behind the pilot's seat and consists of two push-button switches (figure 494).

(b) TEST AFTER INSTALLATION.—Refer to section X on service inspections for communications equipment.

(5) ANTENNA.

(a) DESCRIPTION.—Antenna coaxial cable is strung from the receiver through the fuselage to a vertical antenna mast which extends downward from the fuselage below the tail cone compartment.

(b) TEST AFTER INSTALLATION.—Refer to section X on service inspections for communications equipment.

s. RADIO SET SCR-515.—Radio set SCR-515 provisions are similar to those described in paragraph 15.*j.*, this section, with the following addition: Mounting provisions are made for two mast antenna AN-80, on the center line of the top of the fuselage, on each side of the navigator's dome.

t. RADIO SET SCR-578-( ).— Provisions are made for the installation of radio set SCR-578-( ) an emergency lift raft transmitting equipment. On some airplanes the equipment is stowed as a loose item; on some airplanes, provisions are made for strapping the equipment to the aft main cargo door. The instruction book for the operation of this set is contained within the sealed kite and balloon.

u. COMMAND RADIO SET SCR-522-( ). (On some airplanes only.)

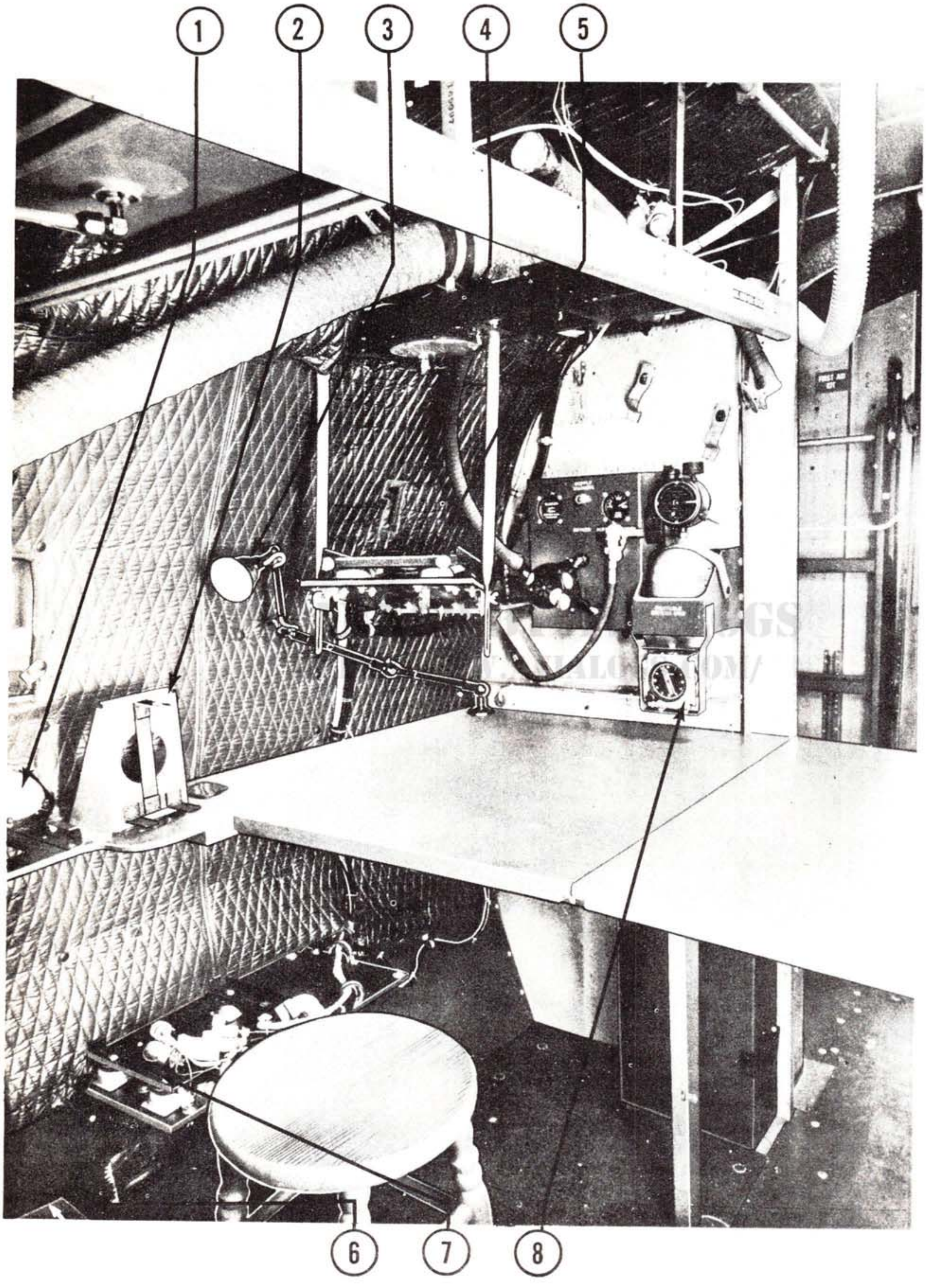


Figure 492—Navigator's Compartment Radio Equipment (C-47A)

KEY TO FIGURE 492

1. Driftmeter (Ref)
2. *AN/APN-2 Radio Control Box Mounting
3. Work Table Lamp
4. Dome Lamp and Switch
5. *AN/APN-2 Radio Indicator Mounting
6. Radio Compass Box and Frequency Meter Mount
7. *AN/APN-2 Transmitter-Receiver Unit Mounting
8. Remote Magnetic Compass Indicator

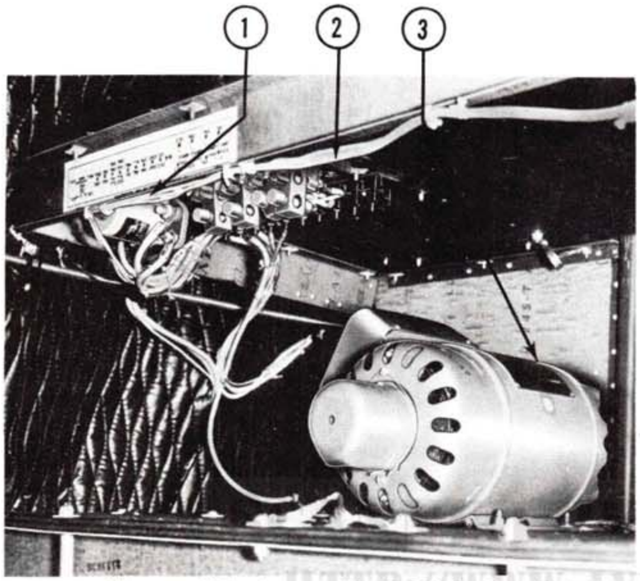


Figure 493—Lower-Shelf—Right-Hand Baggage Compartment 14.509

1. Inverter Relay
2. Inverter Relay Terminal Panel
3. Inverter

(1) GENERAL.—Command radio set SCR-522-( ) is a very high-frequency receiving and transmitting equipment for communication between aircraft in flight and between aircraft and ground stations. It consists of a receiver-transmitter assembly, a dynamotor, a remote control box, and an antenna. Power for this radio equipment is obtained by connection through a 40-ampere fuse to the compass junction box power bus. A C.H. 8710 command set selector switch ("VHF-MED FREQ") is mounted above the right-hand electrical panel (6, figure 459). The switch is normally in the "MED FREQ" position, which connects command radio set SCR-274-N to the "COMMAND" position of the interphone jack boxes. When the switch is in the "VHF" (very high frequency) position, radio set SCR-522-( ) is connected to the "COMMAND" position of the interphone jack boxes. A carbon microphone adapter M-299 is installed on the aft bulkhead of the lavatory compartment and is provided to adapt the interphone system to the very high-frequency radio operation. This radio set is used in conjunction with the interphone system as described in paragraph 15.*q.*, this section.

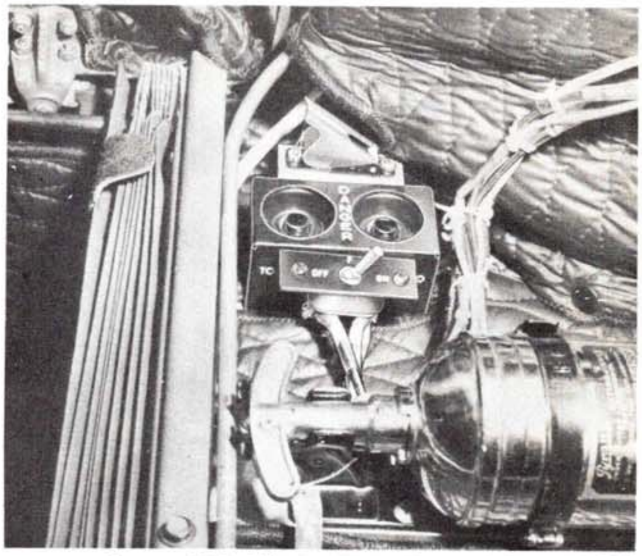


Figure 494—Pilot's IFF Radio Switches 14.510

AVIALOGS

(2) DESCRIPTION.

(a) TRANSMITTER-RECEIVER ASSEMBLY.—The transmitter-receiver assembly consists of transmitter BC-625-( ) and receiver BC-624-( ) mounted together in case CS-80-( ) on the shock-mounted rack FT-244-( ), installed on the right-hand side of the tail cone compartment. Both the transmitter and the receiver are simultaneously switched to any of the four available, preset, crystal controlled channels in the frequency range 100 to 156 megacycles whenever the appropriate channel-selector pushbutton on the remote control box is pressed. Remote control only is provided.

1. TRANSMITTER BC-625-( ).—The top of the transmitter is equipped with four tuning controls, a receptacle for the d-c meter cord, and a "METER SWITCH." The antenna-coupling control is located on the right side of the transmitter panel and the "GAIN" control is on the left. The crystal sockets are to the right of the meter switch and are identified by the channel letters "A," "B," "C," and "D."

2. RECEIVER BC-624-( ).—All tuning controls and installation-adjustment controls are located on the receiver panel and are easily accessible.

3. RACK FT-244-( ).—Rack FT-244-( ), besides serving as a mounting base for the receiver and transmitter, contains the interconnecting wires for the receiver and transmitter, plug sockets for the attachment of cables from the other parts of the set, the antenna changeover switch, the channel-control motor, and other associated mechanism and equipment. The rack is provided with front and rear covers attached by means of a slot-and-screw arrangement which makes it possible to slide them away and gain access to the transmitter (front) and receiver (rear).

(b) DYNAMOTOR UNIT PE-94-( ).—Dynamotor unit PE-94-( ) is the source for the regulated

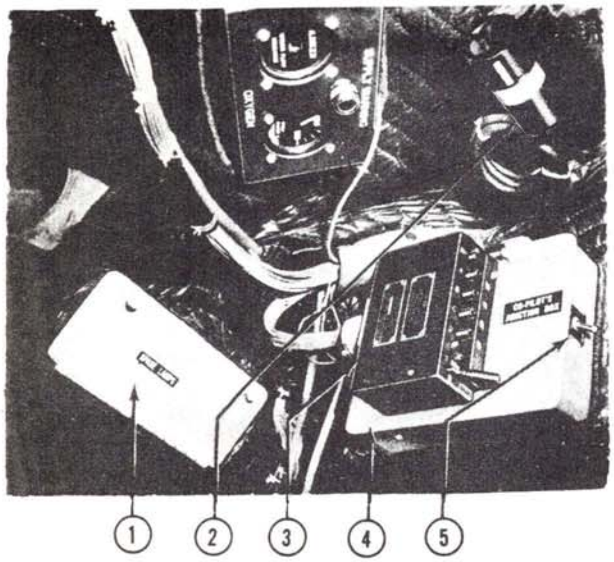


Figure 495—Right-Hand Rear Corner—Pilots' Compartment

1. Spare Lamps Box
2. Type C-4 Extension Lamp
3. SCR-522-( ) Command Radio Remote Control Box
4. Copilot's Radio Junction Box
5. Liaison Transmitter Remote Control Switch

voltages required for the operation of the transmitter-receiver assembly and is shock-mounted on a shelf on the right-hand side of the tail cone compartment.

(c) REMOTE CONTROL BOX BC-602-( ). *(3, figure 495.)*—The remote control box for radio set SCR-522-( ) is mounted on the copilot's junction box, behind and above the copilot's seat. The box contains the following controls: five push-button switches, an "OFF" switch and four channel selection switches; a "T-R-REM" selector switch; a locking lever which, when it is lowered, blocks the "T-R-REM" switch from the "REM" position and spring-loads the switch lever so that unless the switch is held in the "T" position it will return to "R"; four green jewel lamps to indicate the channel in operation; a white jewel lamp to indicate when the equipment is set for receiving; and, a dimming mask lever which reduces the glare of the indicator lamps. The "T-R-REM" switch positions have the following functions: "T"—the transmitter is placed in continuous operation; "R"—the receiver is placed in continuous operation; "REM"—places the receiver in operation until the microphone push-to-talk switch is closed, when the transmitter is placed in operation. When the "OFF" pushbutton switch is pressed, the dynamotor is stopped and the set is turned "OFF."

(d) ANTENNA.—The antenna is strung from the transmitter-receiver assembly to antenna mast AN-104-( ) mounted on the top of the fuselage, forward of the main cargo door.

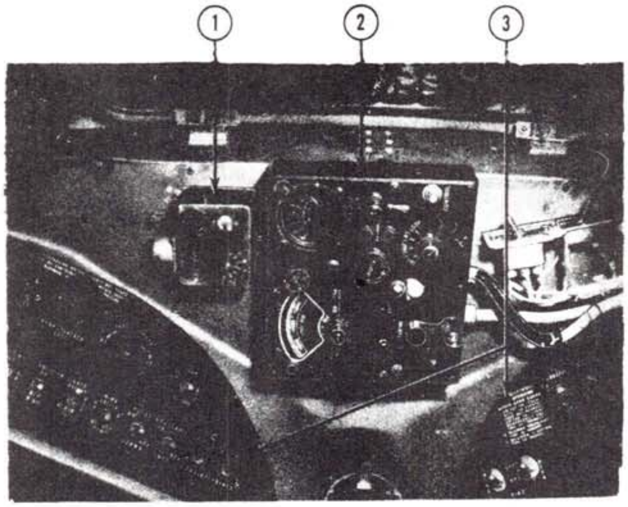


Figure 496—SCR-269-G Radio Compass and RC-103-( )—Receiver Control Boxes

1. RC-103-( ) Radio Control Box
2. SCR-269-G Radio Compass Control Box
3. Electrical Panels (Ref)

(3) REMOVAL AND MAINTENANCE. – Refer to section X on service inspections for communications equipment.

Note

Do not remove or disassemble any part of radio set SCR-522-( ) unless this is absolutely necessary for maintenance repairs or replacement. Needless tampering may lead to faulty operation or damaged equipment.

v. RADIO SET *AN/APN-2 (on some airplanes only).—Radio set *AN/APN-2 is a beacon radio transmitting and receiving equipment consisting of receiver and transmitter *RT-1/APN-2, mounted on a shelf in the outboard, aft corner of the navigator's compartment; indicator BC-929-A, mounted above the navigator's table; control box *C-3/APN-2, mounted on the outboard wall of the navigator's compartment;

KEY TO FIGURE 497

1. Liaison Transmitter Tuning Units
2. Interphone Dynamotor
3. Command Antenna Switching Relay
4. Command Transmitters
5. Command Receivers
6. Liaison Antenna Changeover Switch
7. Liaison and Command Junction Box
8. Liaison Transmitter
9. Radio Operator's Suit Heat Rheostat
10. Liaison Loop Antenna Dehydrator
11. Liaison Dynamotor
12. Marker Beacon Receiver
13. Liaison Transmitter Antenna Tuning Unit
14. Radio Operator's Interphone Jack Box
15. Liaison Receiver
16. Compass Junction Box
17. Liaison Trailing Antenna Reel Control Box

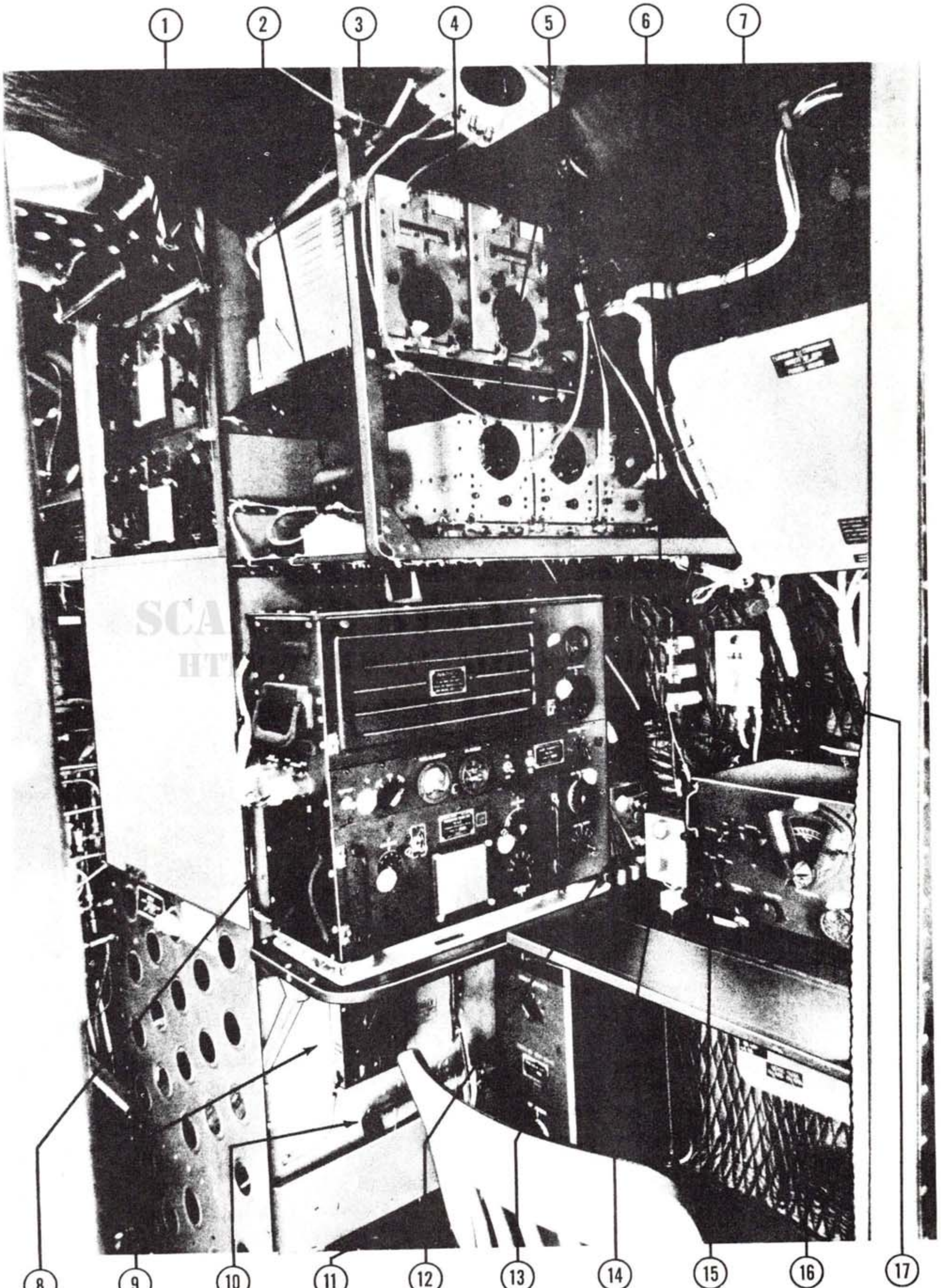

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

Figure 497—Radio Operator's Compartment (C-47A)

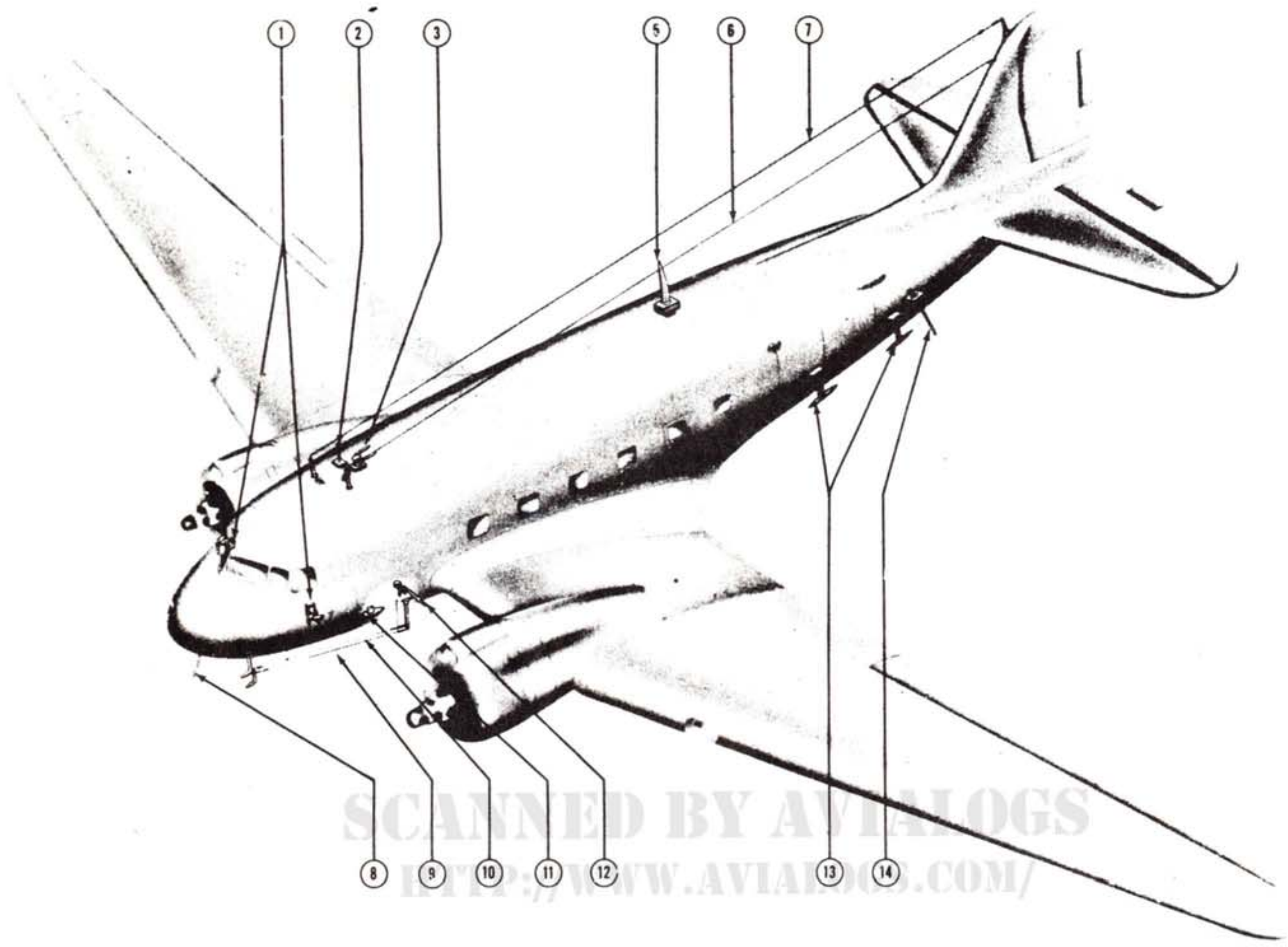


Figure 498—Radio Antennas

1. *AN/APN-2 Antenna *AT-2/APN-2
2. *AN/ARR-1 Antenna *AT-5/ARR-1
3. RC-103-( ) Antenna AN 100
5. SCR-522-( ) Antenna AN 104
6. Liaison Radio Antenna
7. Command Radio Antenna
8. *AN/APN-2 Antenna *AT-1/APN-2
9. Radio Compass Nondirectional Antenna
10. Marker Beacon Antenna
11. Radio Compass Loop Antenna
12. Liaison Radio Trailing Antenna and Reel
13. *AN/APN-1 Antenna *AT-4/ARN-1
14. SCR-595-( ) or 695-( ) Antenna (C-47A Only)

an antenna *AT-2/APN-2 assembly mounted on each side of the forward fuselage, extending from below each side window of the pilots' compartment; and one antenna *AT-1/APN-2 mast mounted extending down from the fuselage nose. The transmitter-receiver is connected to the radio compass inverter for the alternating current needed for operation. To eliminate "skip" (a change of several megacycles in the transmitter frequency with a very small change in the transmitter tuning adjustment), an 18-foot 6-inch length of cable, RG-8/U, is installed as the transmission line.

w. RADIO RECEIVING EQUIPMENT RC-103-( ).

(1) GENERAL.—Radio receiving equipment RC-103-( ) is designed to give lateral guidance to a pilot during landing operations. Vertical guidance is accomplished by glide path receiver AN/ARN-5-( ) described in paragraph 15.*ll.*, this section. The equipment includes the following units: a receiver, BC-733-( ), a dynamotor, DM-53-( ), mounted on the back end of the receiver, a control box, BC-732-( ), an indicator I-101-( ), and a mast antenna AS-27( ). The receiver is capable of accepting continuous wave radio-frequency power, amplitude modulated at two audio frequencies, amplifying and delivering it as audio-frequency power to a filter rectifier network where the two audio frequencies are separated and applied to an indicator. The receiver also delivers amplified audio-frequency power to headsets simultaneously. A 1000-ohm resistor is incorporated to limit the current through the crystal control relays to the proper value.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Do not make adjustments while dynamotor is running.

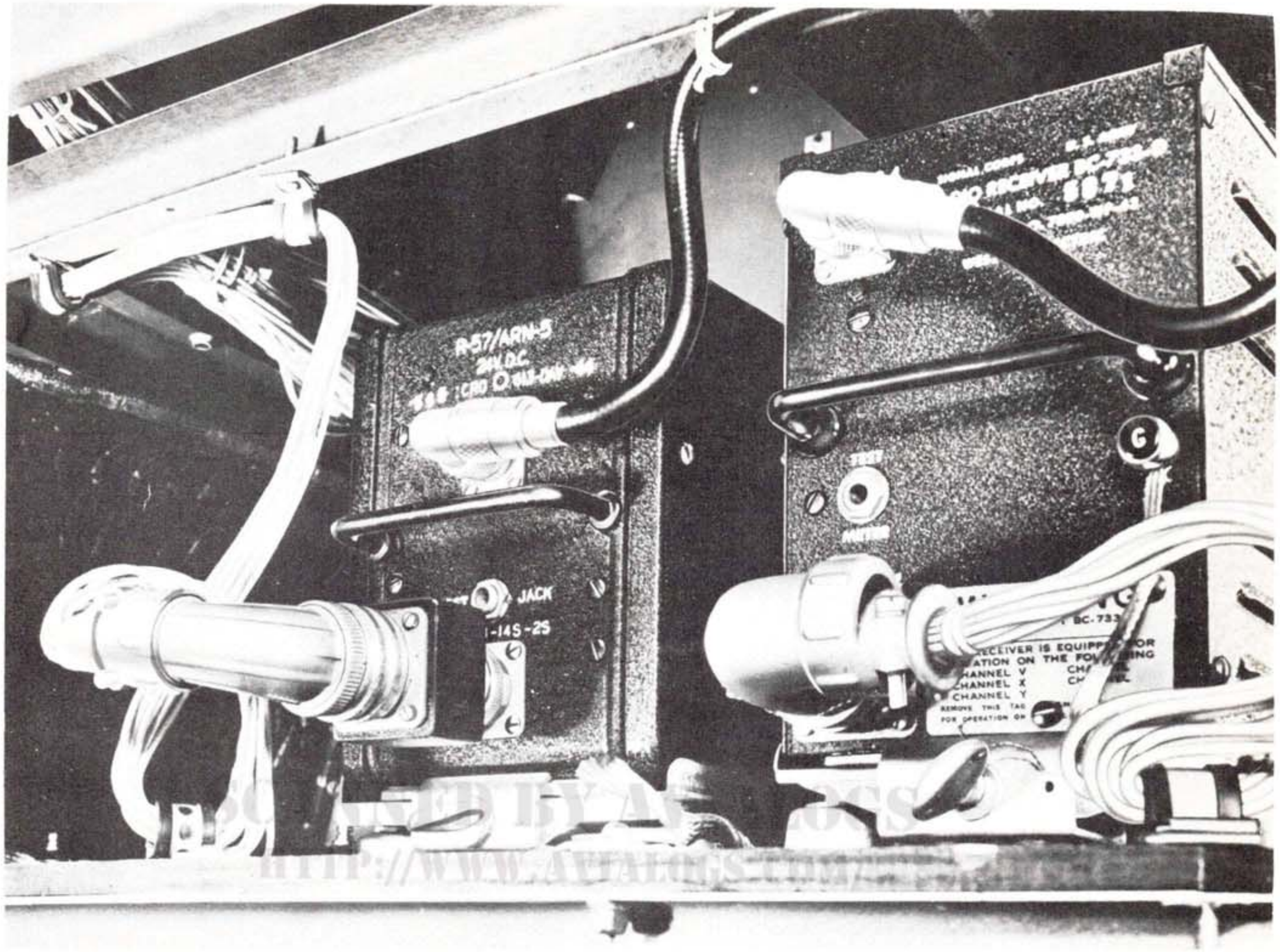


Figure 498A—Radio Receiver BC-733-( ) (Right) Radio Receiver R-57/ARN-5 (Left)

(2) DESCRIPTION.

(a) RECEIVER BC-733-( ). *(See figure 498a.)* The Radio Receiver is shock mounted on mounting FT-293-( ) in the right hand baggage compartment on the lower shelf. It is designed to operate at six fixed, crystal-controlled frequencies of 108.3, 108.7, 109.1, 109.5, 109.9, and 110.3 megacycles.

(b) RADIO CONTROL BOX BC-732-( ). The remote control box type BC-732-( ) is installed in the pilots' compartment above the left hand electrical panel (1, figure 496). It is used for monitoring the receiver, tuning to any one of its six resonant frequencies, and for tuning the receiver "ON" or "OFF."

(c) INDICATOR I-101-( ). *(See 4, figures 477b and 498c.)* The type I-101-( ) indicator installed on the left-hand end of the instrument panel, provides a visual indication to the pilot of his lateral position in respect to the runway. When the receiver is turned to the field localizer transmitter a 90 and 150 cycle modulation will be audible in the headset, while the indicator will produce the signals visually. Unless the airplane's antenna is exactly "ON COURSE" the indicator needle will deflect either to the blue or the yellow side of the dial. If the indicator is on the yellow area (150 cycle modulation) the airplane is on the yellow side of the course. If the pointer is in the blue area (90 cycle modulation) the aircraft is on the blue side of the course. This is true regardless of the heading of the airplane so that other reference will have to be made to establish the correct heading when flying the localizer.

(d) ANTENNA MAST AS-27-( ). *(See figure 498b.)* The antenna is located on the top of the fuselage and aft of the navigator's dome. It is designed for reception of horizontally polarized signals as used for localizer and range operation. The signals are furnished to the receiver through the balance transmission line. Antenna System AS-27/ARN-5 has, in addition to the straight dipole antenna for Radio Receiver R-57/ARN-5 or R-89/ARN-5A (1, figure 498b), a folded parallel dipole antenna for use with Radio Receiver BC-733-( ) (2, figure 498b) (part of Radio Receiving Equipment RC-103-( )). It also has two transmission-cable Sockets SO-264 in the base of the antenna mount (3 and 4, figure 498b).

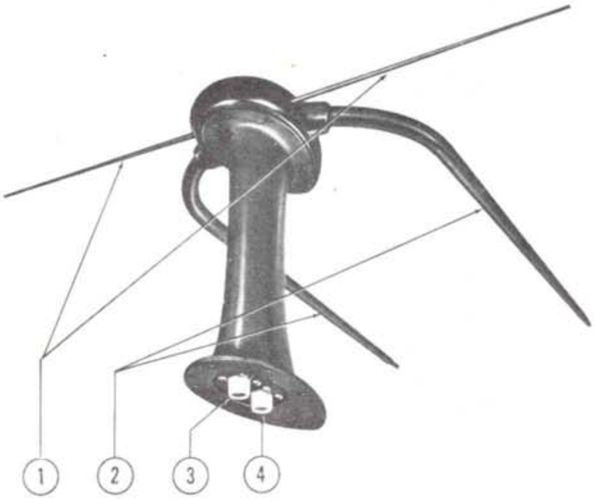


Figure 498B—AS-27-( )/ARN-5 Antenna

1. Antenna for R-57/ARN-5 or R-89/ARN-5A
2. Antenna for Radio Receiver BC-733-D
3. Socket SO-264 for Radio Receiver R-57/ARN-5 or R-89/ARN-5A Antenna Cable
4. Socket SO-264 for Radio Receiver BC-733-D Antenna Cable

(3) REMOVAL.

(a) RECEIVER BC-733-( ).

1. Disconnect the electrical plug and antenna leads.

2. Loosen knurled nut and movable flap on the front of receiver that secures receiver box to the mounting.

3. Lift the receiver from its mounting.

4. The dynamotor may be removed from its mounting on the rear of the receiver by unsnapping the four snap slides and lifting the unit straight up to disengage the plug from its receptacle.

(b) RADIO CONTROL BOX BC-732-( ).

1. Disconnect the electrical plug.

2. Disengage snap slides.

3. Lift out control box.

(c) INDICATOR I-101-( ).

1. Disconnect the electrical plug.

2. Remove four mounting screws.

3. Lift out.

(d) ANTENNA MAST AS-27-( ).—The antenna is removed by disconnecting the plug from the receptacle on the base of the antenna and detaching the four mounting bolts.

(4) INSTALLATION.

(a) RECEIVER BC-733-( ).

1. Install dynamotor to rear of receiver.

2. Replace receiver on to its mount.

3. Tighten knurled nut and movable flap on front of receiver.

4. Connect electrical plug and antenna lead.

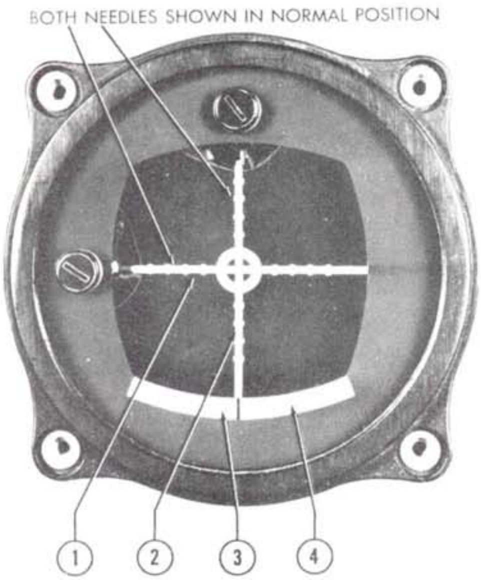


Figure 498C—Glide Path Indicator

1. Indicator Needle for Radio Receiver R-57/ARN-5 or R-89/ARN-5A
2. Indicator Needle for Radio Receiver BC-733-D
3. Blue Band
4. Yellow Band

(b) RADIO CONTROL BOX BC-732-( ).

1. Remount control box.

2. Engage snap slides.

3. Connect electrical plug.

(c) INDICATOR I-101-( ).

1. Remount indicator.

2. Attach with four mounting screws.

3. Connect electrical plug.

(d) ANTENNA MAST AS-27-( ).

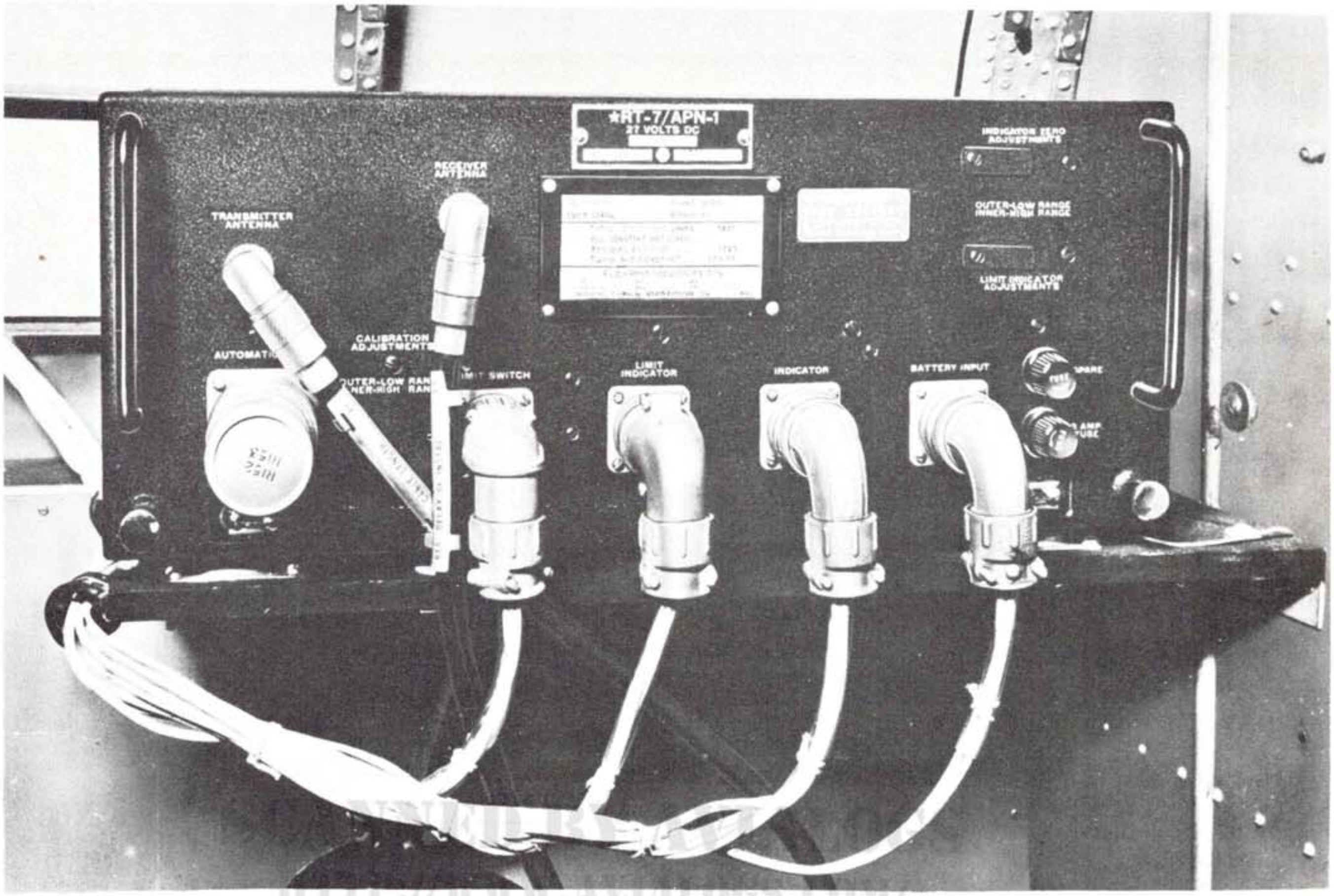
1. Attach the four mounting bolts.

2. Remount antenna mast.

3. Connect the plug to the receptacle on base of antenna.

(5) MAINTENANCE AND ADJUSTMENT.—Refer to Section X, Service Inspection, for Communications Equipment.

x. RADIO RECEIVING EQUIPMENT *AN/ARR-1 (on some airplanes only).—Radio receiving equipment *AN/ARR-1 consists of receiver *R-1/ARR-1, mounted on the underside of the forward radio shelf in the radio operator's compartment below radio set SCR-274-N receivers; remote "ON-OFF" switch in the pilot's compartment, above the right-hand electrical panel relay *RE-1/ARR-1, mounted on the aft bulkhead of the navigator's compartment; and rigid antenna *AT-5/ARR-1, protruding from the top of the fuselage, near the navigator's dome. Inspection information is given in section X of this handbook. Because of the confidential status of the equipment, all additional information concerning this radio set must be taken from the handbook of maintenance instructions.



OWNED BY AVIALOGS

*Figure 498D—Transmitter Receiver *RT-7/APN-1*

y. RADIO ALTIMETER *AN/APN-1.

(1) GENERAL.—The Radio Altimeter *AN/APN-1 equipment is a 14 tube set designed to provide direct measurement of altitude relative to the terrain during flight. The equipment includes the following units: a transmitter-receiver *RT-7/APN-1, a double range altitude indicator, *ID-14/APN-1, containing the power switch knob and the range knob, three indicator lamps, an altitude limit switch *SA-1/APN-1, and two antennas, *AT-4/ARN-1. The 27 volt rated *AN/APN-1 equipment is designed for d-c operation at 22 to 29.5 volts and consumes approximately 2.7 amperes with 27 volts delivered to the battery input receptacle of the Radio Transmitter Receiver.

(2) DESCRIPTION.

(a) TRANSMITTER-RECEIVER *RT-7/APN-1. *(See figure 498d.)* The Transmitter-Receiver is shock-mounted on a shelf on the right-hand side of the lavatory compartment. The unit includes the mounting base No. *MT-14/ARN-1, and the necessary accessories for operation. On the front of the unit are the following: access holes for calibration adjustments, limit indicator adjustments, and indicator zero adjustments; sockets for the receiver antenna plug, transmitter antenna plug, the automatic pilot plug (containing the "dummy pilot" plug P108 as required when the installation does not include the automatic pilot system), the limit switch plug, the indicator plug, the limit indicator plug, the battery plug; receptacles for a 3-amp. fuse, and a spare fuse.

(b) DOUBLE RANGE INDICATOR *ID-14/APN-1. *(See figures 498e and 477b.)*—The double Range indicator is mounted on the left-hand side of the instrument panel and contains the power switch knob, the range switch knob and three indicator lamps (one red, one amber, and one green), mounted next to the indicator for use with the indicator and limit switch. The range switch control is used for selecting the desired altitude range and is geared to a shutter which changes the scale numerals to correspond to the range for which the control is set.

(c) ALTITUDE LIMIT SWITCH *SA-1/ARN-1. *(See figure 498f.)*—The altitude limit switch is mounted in the pilots' compartment between the two electrical panels and directly below the ignition switch. This switch determines the "pre-set" altitude with reference to which the altitude limit indicator operates.

(d) ANTENNAS *AT-4/ARN-1. *(See figure 498g.)*—The two antennas are mounted on the under surfaces of the aft fuselage. One is used for transmitting, the other for receiving. The antennas are identical in mechanical and electrical characteristics.

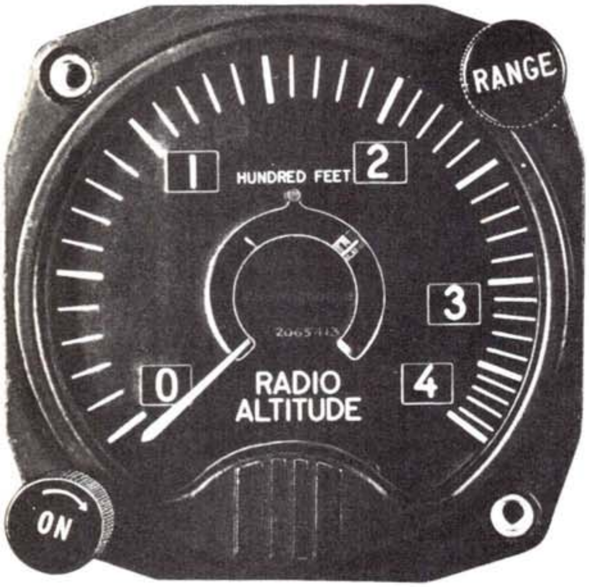


*Figure 498E—Double Range Indicator *ID-14/APN-1*

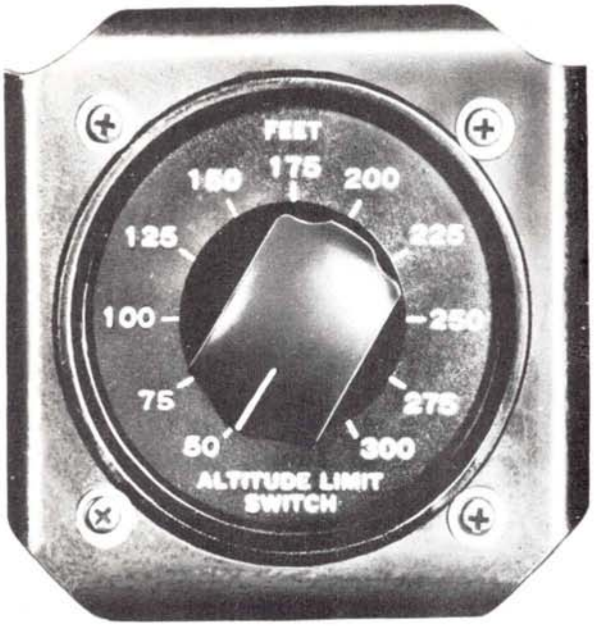


*Figure 498F—Altitude Limit Switch *SA-1/ARN-1*

(3) REMOVAL.

(a) TRANSMITTER-RECEIVER UNIT.

1. The chassis and front panel together with the dust cover comprise a unit which is detachable from the mounting.

a. Loosen the two snap fasteners.

b. Pull unit forward one inch and lift one-half inch to clear angles on shock mounting.

2. Also the chassis including the front panel can be removed from the dust cover (without detaching the latter from the mounting).

a. Loosen two thumb screws.

b. Pull chassis forward seven inches to clear the dust cover.

(b) DOUBLE RANGE INDICATOR.

1. Loosen and remove two setscrews securing indicator to the instrument panel.

2. Remove indicator from the instrument panel, unscrew and remove plug from the back of the indicator.

(c) ALTITUDE LIMIT SWITCH.

1. Unscrew and remove plug from back of switch.

2. Remove four screws from switch and remove switch from mounting.

(d) ANTENNAS.

1. Remove four screws securing each antenna to the fuselage.

2. Disconnect the r-f transmission line.

(e) INDICATOR LAMPS.—To replace a burned out indicator lamp:

1. Unscrew and remove lamp housing.

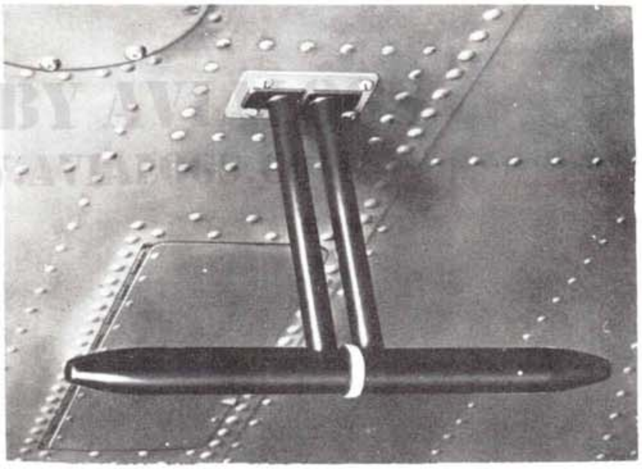


*Figure 498G—Antenna *AT-4/ARN-1*

2. Remove bulb and replace.

(4) INSTALLATION.

(a) TRANSMITTER-RECEIVER UNIT.

1. Install unit on shock mounting.

2. Engage the two snap fasteners.

(b) DOUBLE RANGE INDICATOR.

1. Install indicator to instrument panel, attach plug to back of indicator.

2. Install and tighten the two set screws to the instrument panel.

(c) ALTITUDE LIMIT SWITCH.

1. Install switch in mounting and secure with four screws.

2. Insert and screw plug into back of switch.

(*d*) ANTENNAS.

1. Connect the r-f transmission line.

2. Secure each antenna to fuselage with four screws.

(*e*) INDICATOR LAMPS.

1. Insert new bulb in socket.

2. Reinstall lamp housing.

(5) MAINTENANCE AND ADJUSTMENT.—Refer to Section X for service inspection of communications equipment.

z. GENERAL (24 VOLT C-47B).—The radio sets installed on the C-47B airplanes are as follows:

(1) COMMAND RADIO SET SCR-274-N.—For communications from airplane to airplane or airplane to station in short range operation. Refer to paragraph 15.*b.*, this section.

(2) COMMAND RADIO SET SCR-522-( ).—For short range communication of very high frequencies. Refer to paragraph 15.*u.*, this section.

(3) LIAISON RADIO SET SCR-287-( ).—For communication from airplane to airplane or airplane to station in long range operation. Refer to paragraph 15.*m.*, this section.

(4) RADIO COMPASS AN/ARN-7.—For navigational purposes. Refer to paragraph 15.*n.*, this section.

(5) MARKER BEACON RECEIVING EQUIPMENT RC-43-( ) or RC-193-( ). *(See figure 498H.)* — For navigation and landing one late C-47B airplane receiver BC-1333 replaces and is interchangeable with receiver BC-357-( ) or BC-1033-( ). Refer to paragraph 15.*o.*, this section.

(6) FREQUENCY METER SET SCR-211-( ).—For testing and adjustment of radio sets. Refer to paragraph 15.*g.*, this section.

(7) INTERPHONE EQUIPMENT RC-36.—For crew member to member communication or crew member participation in radio operations. Refer to paragraph 15.*q.*, this section.

(8) IDENTIFICATION RADIO SET SCR-695-( ) or SCR-515-( ).—For recognition purposes. Refer to paragraph 15.*r.*, and 15.*s.*, this section.

(9) BEACON RADIO SET AN/APN-2. Refer to paragraph 15.*v.*, this section.

(10) ALTIMETER RADIO SET AN/APN-1.—Provides direct measurement of altitude relative to the terrain during flight. Refer to paragraph 15.*y.*, this section.

(11) RADIO SET SCR-578-( ).—Emergency life raft equipment. Provisions only are made for installation of this equipment. Refer to paragraph 15.*t.*, this section.

(12) RADIO RECEIVING EQUIPMENT RC-103-( ) and glide path receiver AN/ARN-5A are installed on some C-47B airplanes. (See figures 496, 498A, 498B and 498C.)

(*a*) GENERAL.—The airborne radio receiving AN/ARN-5-( ) is designed to give vertical guidance to the pilot during landing operations. This part of the navigational system provides both lateral and vertical guidance, lateral guidance being supplied by radio receiving equipment RC-103-( ). Refer to paragraph 15.*w.*, this section.

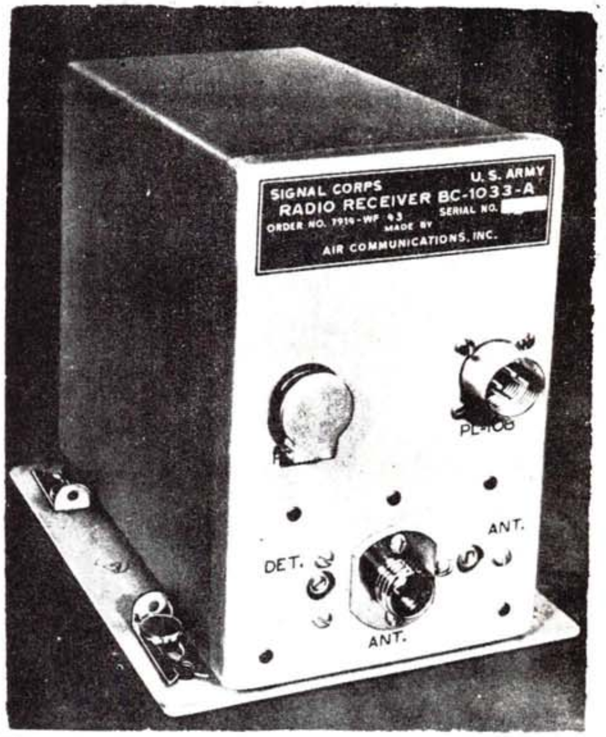


Figure 498H—Marker Beacon Receiver

(*b*) DESCRIPTION.

1. RADIO RECEIVER R-89/ARN-5A OR R-57/ARN-5 WITH ADAPTER U-19/ARN. *(See figure 498A.)*—The radio receiver is shock mounted on mounting MT-28/ARN-5A in the right-hand baggage compartment on the lower shelf. The receiver is designed to operate at one of three frequencies: 332.6, 333.8, or 335.0 megacycles. The operating frequency is changed by changing the crystal. The two crystals not in use are stored in the receiver. The receiver r-f carrier is amplitude modulated at 90 and 150 cycles per second. The operating frequency is changed by means of the selector switch on radio control box BC-732-( ).

2. RADIO CONTROL BOX BC-732-A, INDICATOR I-101-C, AND ANTENNA MAST AS-27-( ).—Refer to paragraph 15.*w.*, this section.

(*c*) REMOVAL.

1. Disconnect plugs from receiver.

2. Loosen the thumbscrew on the front of the mounting.

3. Slide receiver forward and remove from mounting.

(*d*) INSTALLATION.

1. Install receiver on mounting.

2. Tighten thumbscrew on front of mounting.

3. Connect plugs to receiver.

(*e*) MAINTENANCE AND ADJUSTMENT.—Refer to Section X on service inspection for communications equipment.

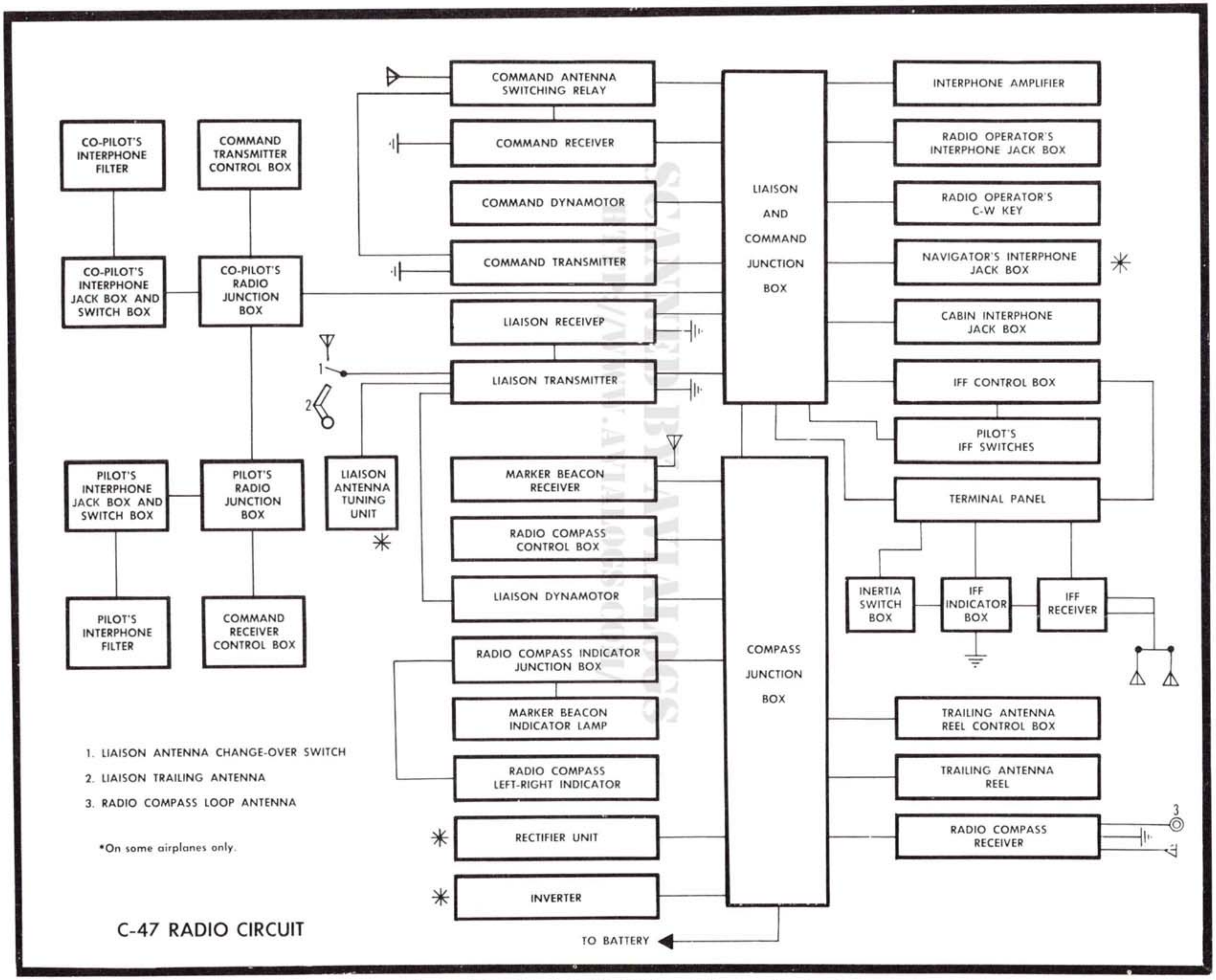

C-47 RADIO CIRCUIT
CO-PILOT'S INTERPHONE FILTER
COMMAND TRANSMITTER CONTROL BOX
CO-PILOT'S INTERPHONE JACK BOX AND SWITCH BOX
CO-PILOT'S RADIO JUNCTION BOX
PILOT'S INTERPHONE JACK BOX AND SWITCH BOX
PILOT'S RADIO JUNCTION BOX
PILOT'S INTERPHONE FILTER
COMMAND RECEIVER CONTROL BOX
LIAISON ANTENNA TUNING UNIT
*
1
2
COMMAND ANTENNA SWITCHING RELAY
COMMAND RECEIVER
COMMAND DYNAMOTOR
COMMAND TRANSMITTER
LIAISON RECEIVEP
LIAISON TRANSMITTER
MARKER BEACON RECEIVER
RADIO COMPASS CONTROL BOX
LIAISON DYNAMOTOR
RADIO COMPASS INDICATOR JUNCTION BOX
MARKER BEACON INDICATOR LAMP
RADIO COMPASS LEFT-RIGHT INDICATOR
* RECTIFIER UNIT
* INVERTER
TO BATTERY
LIAISON AND COMMAND JUNCTION BOX
COMPASS JUNCTION BOX
INTERPHONE AMPLIFIER
RADIO OPERATOR'S INTERPHONE JACK BOX
RADIO OPERATOR'S C-W KEY
NAVIGATOR'S INTERPHONE JACK BOX *
CABIN INTERPHONE JACK BOX
IFF CONTROL BOX
PILOT'S IFF SWITCHES
TERMINAL PANEL
INERTIA SWITCH BOX
IFF INDICATOR BOX
IFF RECEIVER
TRAILING ANTENNA REEL CONTROL BOX
TRAILING ANTENNA REEL
RADIO COMPASS RECEIVER
3
1. LIAISON ANTENNA CHANGE-OVER SWITCH
2. LIAISON TRAILING ANTENNA
3. RADIO COMPASS LOOP ANTENNA
*On some airplanes only.

Figure 499—Block Radio Wiring Diagram for C-47

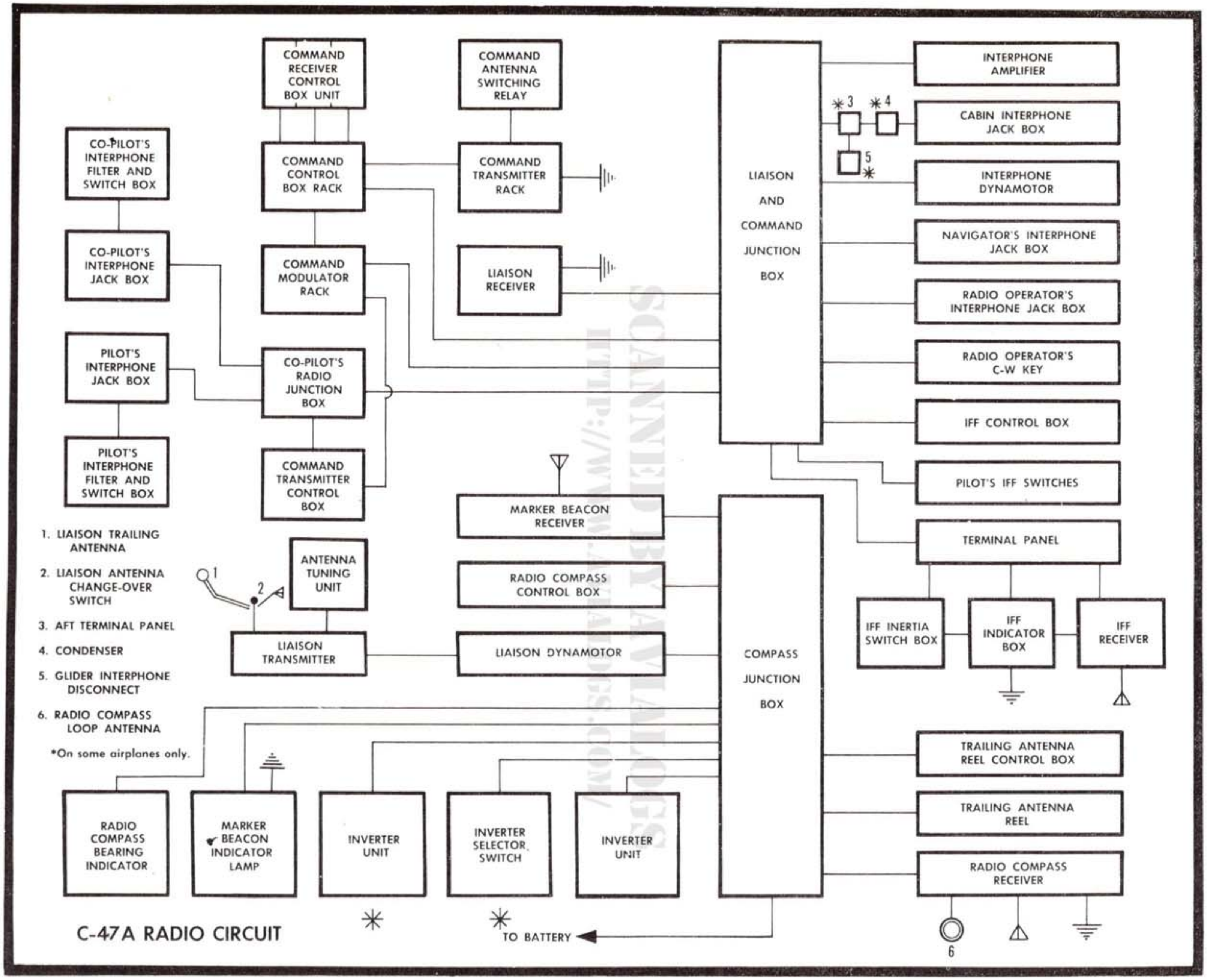

COMMAND RECEIVER CONTROL BOX UNIT
COMMAND ANTENNA SWITCHING RELAY
CO-PILOT'S INTERPHONE FILTER AND SWITCH BOX
COMMAND CONTROL BOX RACK
COMMAND TRANSMITTER RACK
CO-PILOT'S INTERPHONE JACK BOX
COMMAND MODULATOR RACK
LIAISON RECEIVER
PILOT'S INTERPHONE JACK BOX
CO-PILOT'S RADIO JUNCTION BOX
PILOT'S INTERPHONE FILTER AND SWITCH BOX
COMMAND TRANSMITTER CONTROL BOX
LIAISON AND COMMAND JUNCTION BOX
INTERPHONE AMPLIFIER
*3
*4
5*
CABIN INTERPHONE JACK BOX
INTERPHONE DYNAMOTOR
NAVIGATOR'S INTERPHONE JACK BOX
RADIO OPERATOR'S INTERPHONE JACK BOX
RADIO OPERATOR'S C-W KEY
IFF CONTROL BOX
PILOT'S IFF SWITCHES
TERMINAL PANEL
IFF INERTIA SWITCH BOX
IFF INDICATOR BOX
IFF RECEIVER
MARKER BEACON RECEIVER
RADIO COMPASS CONTROL BOX
LIAISON DYNAMOTOR
ANTENNA TUNING UNIT
LIAISON TRANSMITTER
1
2
COMPASS JUNCTION BOX
TRAILING ANTENNA REEL CONTROL BOX
TRAILING ANTENNA REEL
RADIO COMPASS RECEIVER
6
RADIO COMPASS BEARING INDICATOR
MARKER BEACON INDICATOR LAMP
INVERTER UNIT
INVERTER SELECTOR SWITCH
INVERTER UNIT
*
*
TO BATTERY
1. LIAISON TRAILING ANTENNA
2. LIAISON ANTENNA CHANGE-OVER SWITCH
3. AFT TERMINAL PANEL
4. CONDENSER
5. GLIDER INTERPHONE DISCONNECT
6. RADIO COMPASS LOOP ANTENNA
*On some airplanes only.
C-47A RADIO CIRCUIT

Figure 500—Block Radio Wiring Diagram for C-47A

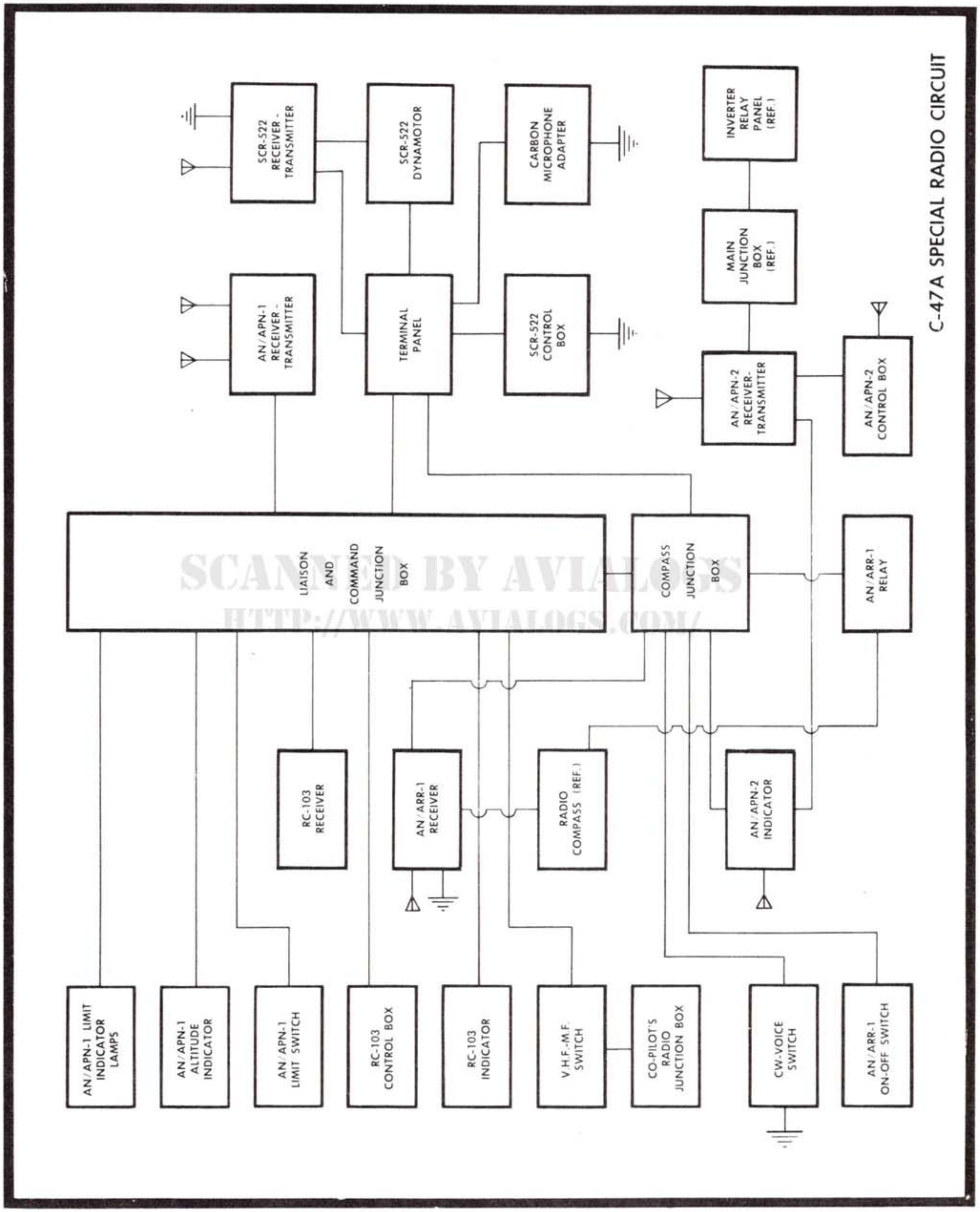

C-47A SPECIAL RADIO CIRCUIT
SCR-522 RECEIVER - TRANSMITTER
SCR-522 DYNAMOTOR
CARBON MICROPHONE ADAPTER
INVERTER RELAY PANEL (REF.)
AN/APN-1 RECEIVER - TRANSMITTER
TERMINAL PANEL
SCR-522 CONTROL BOX
MAIN JUNCTION BOX (REF.)
AN/APN-2 RECEIVER-TRANSMITTER
AN/APN-2 CONTROL BOX
LIAISON AND COMMAND JUNCTION BOX
COMPASS JUNCTION BOX
AN/ARR-1 RELAY
RC-103 RECEIVER
AN/ARR-1 RECEIVER
RADIO COMPASS (REF.)
AN/APN-2 INDICATOR
AN/APN-1 LIMIT INDICATOR LAMPS
AN/APN-1 ALTITUDE INDICATOR
AN/APN-1 LIMIT SWITCH
RC-103 CONTROL BOX
RC-103 INDICATOR
V.H.F.-M.F. SWITCH
CO-PILOT'S RADIO JUNCTION BOX
CW-VOICE SWITCH
AN/ARR-1 ON-OFF SWITCH

Figure 501—Block Wiring Diagram for Special Radio Equipment in C-47A

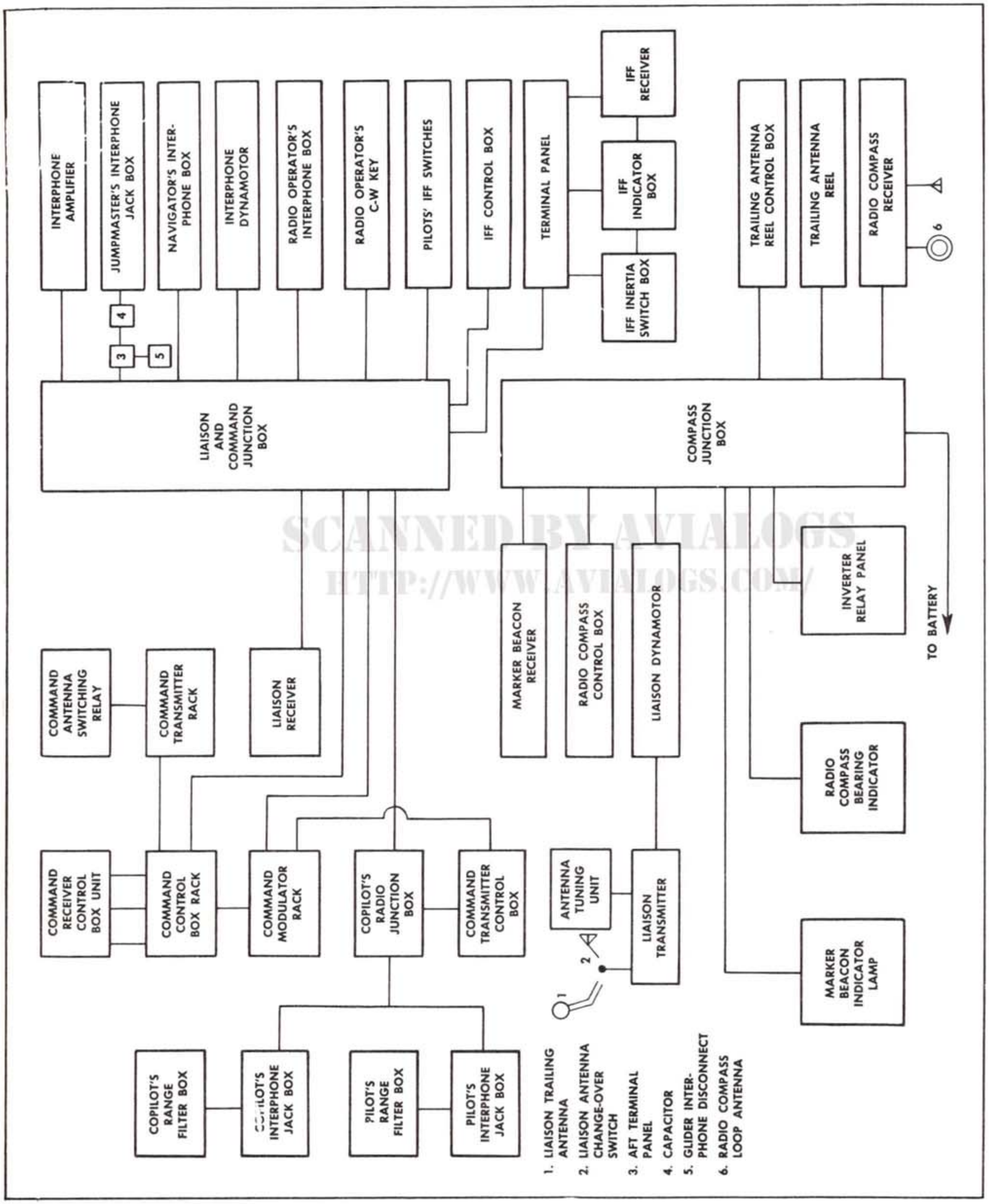

INTERPHONE AMPLIFIER
JUMPMASTER'S INTERPHONE JACK BOX
NAVIGATOR'S INTER-PHONE BOX
INTERPHONE DYNAMOTOR
RADIO OPERATOR'S INTERPHONE BOX
RADIO OPERATOR'S C-W KEY
PILOTS' IFF SWITCHES
IFF CONTROL BOX
TERMINAL PANEL
IFF RECEIVER
IFF INDICATOR BOX
IFF INERTIA SWITCH BOX
TRAILING ANTENNA REEL CONTROL BOX
TRAILING ANTENNA REEL
RADIO COMPASS RECEIVER
3
4
5
6
LIAISON AND COMMAND JUNCTION BOX
COMPASS JUNCTION BOX
TO BATTERY
MARKER BEACON RECEIVER
RADIO COMPASS CONTROL BOX
LIAISON DYNAMOTOR
INVERTER RELAY PANEL
COMMAND ANTENNA SWITCHING RELAY
COMMAND TRANSMITTER RACK
LIAISON RECEIVER
RADIO COMPASS BEARING INDICATOR
COMMAND RECEIVER CONTROL BOX UNIT
COMMAND CONTROL BOX RACK
COMMAND MODULATOR RACK
COPILOT'S RADIO JUNCTION BOX
COMMAND TRANSMITTER CONTROL BOX
ANTENNA TUNING UNIT
LIAISON TRANSMITTER
MARKER BEACON INDICATOR LAMP
1
2
COPILOT'S RANGE FILTER BOX
COPILOT'S INTERPHONE JACK BOX
PILOT'S RANGE FILTER BOX
PILOT'S INTERPHONE JACK BOX
1. LIAISON TRAILING ANTENNA
2. LIAISON ANTENNA CHANGE-OVER SWITCH
3. AFT TERMINAL PANEL
4. CAPACITOR
5. GLIDER INTER-PHONE DISCONNECT
6. RADIO COMPASS LOOP ANTENNA

Figure 501A—Block Wiring Diagram for Most C-47B's

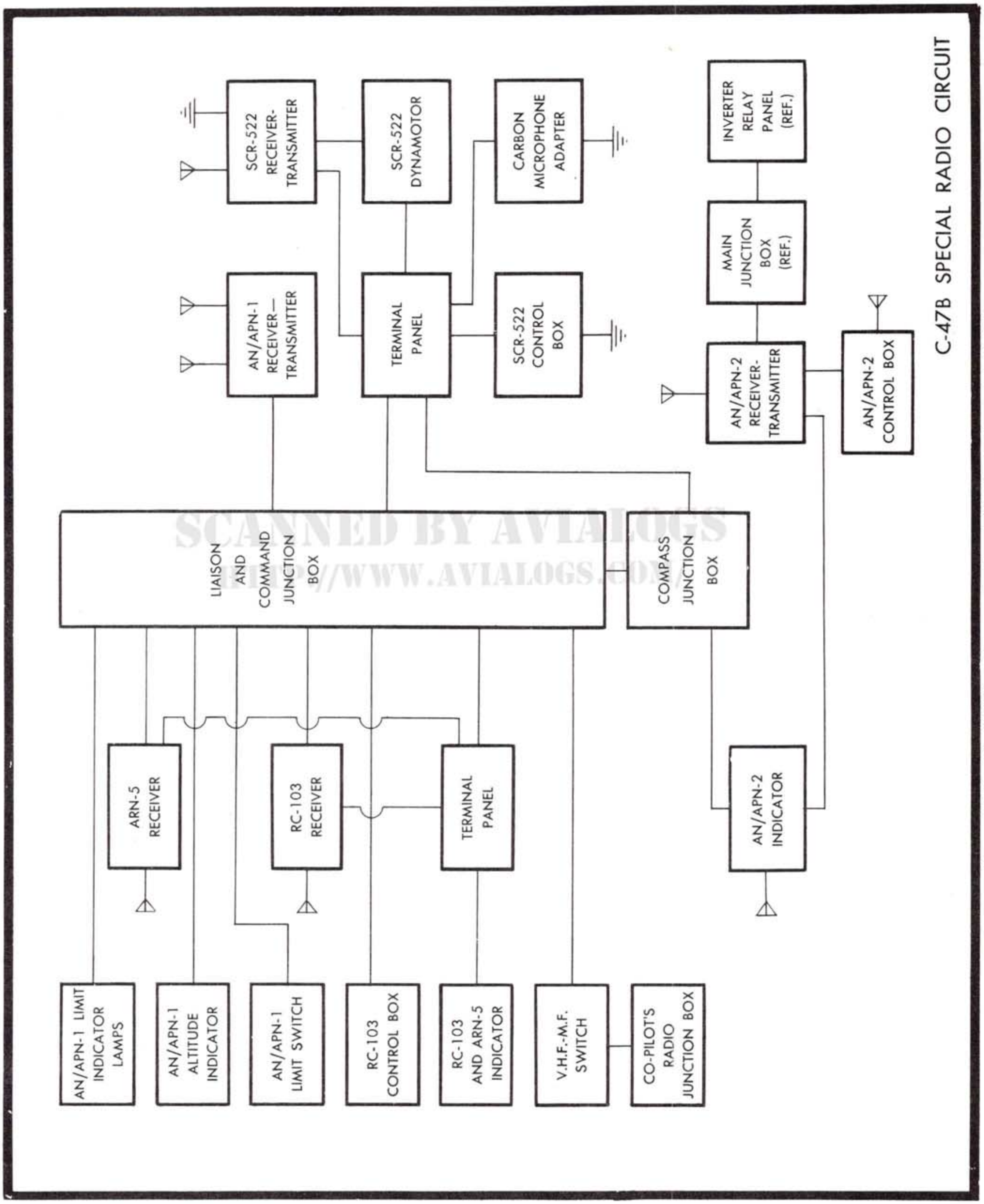

C-47B SPECIAL RADIO CIRCUIT
SCR-522 RECEIVER-TRANSMITTER
SCR-522 DYNAMOTOR
CARBON MICROPHONE ADAPTER
INVERTER RELAY PANEL (REF.)
AN/APN-1 RECEIVER—TRANSMITTER
TERMINAL PANEL
SCR-522 CONTROL BOX
MAIN JUNCTION BOX (REF.)
AN/APN-2 RECEIVER-TRANSMITTER
AN/APN-2 CONTROL BOX
LIAISON AND COMMAND JUNCTION BOX
COMPASS JUNCTION BOX
ARN-5 RECEIVER
RC-103 RECEIVER
TERMINAL PANEL
AN/APN-2 INDICATOR
AN/APN-1 LIMIT INDICATOR LAMPS
AN/APN-1 ALTITUDE INDICATOR
AN/APN-1 LIMIT SWITCH
RC-103 CONTROL BOX
RC-103 AND ARN-5 INDICATOR
V.H.F.-M.F. SWITCH
CO-PILOT'S RADIO JUNCTION BOX

Figure 501B—Block Wiring Diagram for Special Radio Equipment in C-47B

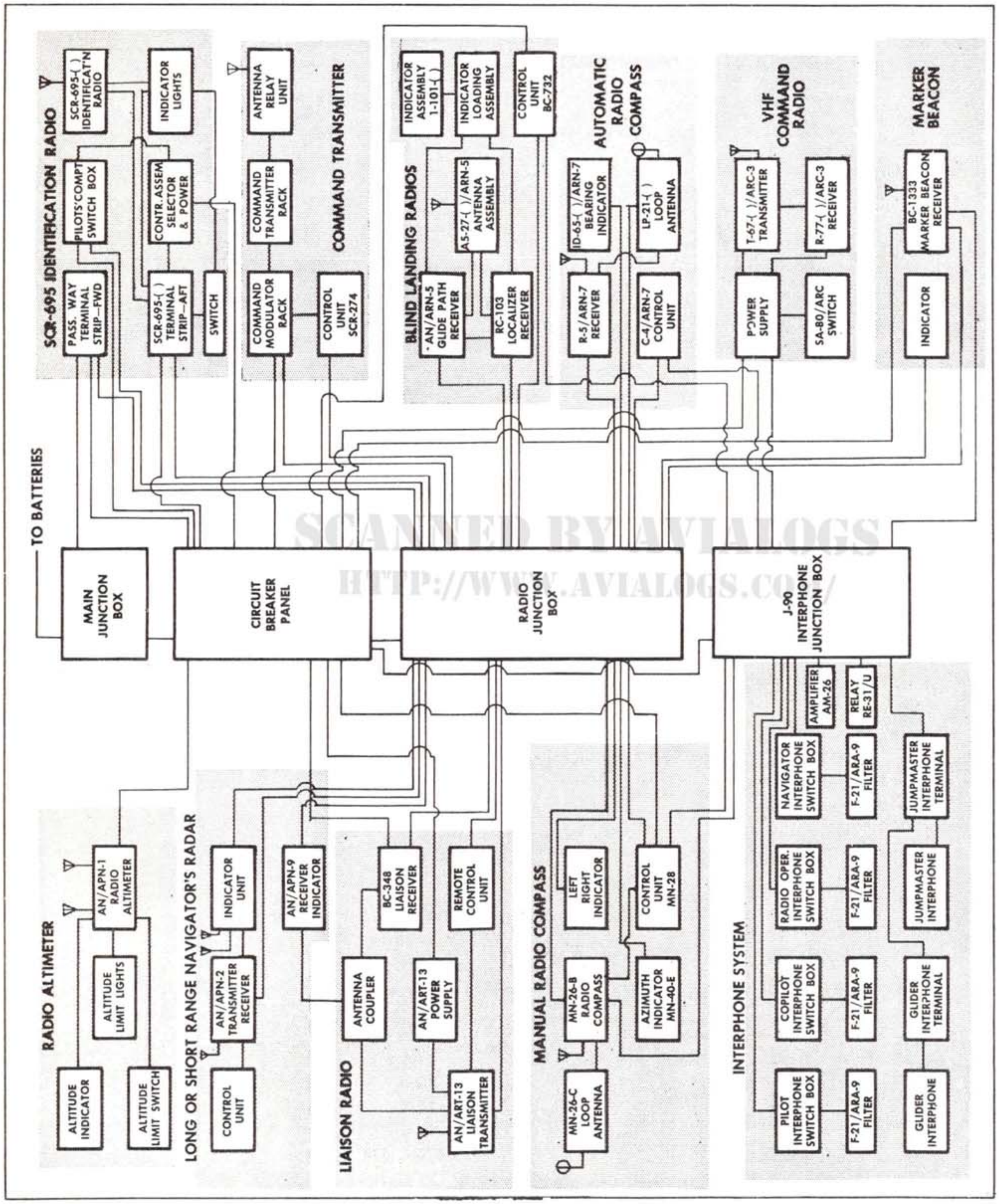

SCR-695 IDENTIFICATION RADIO
PASS. WAY TERMINAL STRIP—FWD
PILOTS' COMPT SWITCH BOX
SCR-695-( ) IDENTIFICAT'N RADIO
SCR-695-( ) TERMINAL STRIP—AFT
CONTR. ASSEM SELECTOR & POWER
INDICATOR LIGHTS
SWITCH
COMMAND TRANSMITTER
COMMAND MODULATOR RACK
COMMAND TRANSMITTER RACK
ANTENNA RELAY UNIT
CONTROL UNIT SCR-274
BLIND LANDING RADIOS
AN/ARN-5 GLIDE PATH RECEIVER
AS-27-( )/ARN-5 ANTENNA ASSEMBLY
INDICATOR LOADING ASSEMBLY
INDICATOR ASSEMBLY I-101-( )
RC-103 LOCALIZER RECEIVER
CONTROL UNIT BC-732
AUTOMATIC RADIO COMPASS
R-5/ARN-7 RECEIVER
ID-65-( )/ARN-7 BEARING INDICATOR
C-4/ARN-7 CONTROL UNIT
LP-21-( ) LOOP ANTENNA
VHF COMMAND RADIO
POWER SUPPLY
T-67-( )/ARC-3 TRANSMITTER
SA-80/ARC SWITCH
R-77-( )/ARC-3 RECEIVER
MARKER BEACON
INDICATOR
BC-1333 MARKER BEACON RECEIVER
TO BATTERIES
MAIN JUNCTION BOX
CIRCUIT BREAKER PANEL
RADIO JUNCTION BOX
J-90 INTERPHONE JUNCTION BOX
RADIO ALTIMETER
ALTITUDE INDICATOR
ALTITUDE LIMIT SWITCH
ALTITUDE LIMIT LIGHTS
AN/APN-1 RADIO ALTIMETER
LONG OR SHORT RANGE NAVIGATOR'S RADAR
CONTROL UNIT
AN/APN-2 TRANSMITTER RECEIVER
INDICATOR UNIT
AN/APN-9 RECEIVER INDICATOR
LIAISON RADIO
AN/ART-13 LIAISON TRANSMITTER
AN/ART-13 POWER SUPPLY
ANTENNA COUPLER
BC-348 LIAISON RECEIVER
REMOTE CONTROL UNIT
MANUAL RADIO COMPASS
MN-26-C LOOP ANTENNA
MN-26-B RADIO COMPASS
AZIMUTH INDICATOR MN-40-E
LEFT RIGHT INDICATOR
CONTROL UNIT MN-28
INTERPHONE SYSTEM
PILOT INTERPHONE SWITCH BOX
COPILOT INTERPHONE SWITCH BOX
RADIO OPER. INTERPHONE SWITCH BOX
NAVIGATOR INTERPHONE SWITCH BOX
AMPLIFIER AM-26
RELAY RE-31/U
F-21/ARA-9 FILTER
F-21/ARA-9 FILTER
F-21/ARA-9 FILTER
F-21/ARA-9 FILTER
GLIDER INTERPHONE
GLIDER INTERPHONE TERMINAL
JUMPMASTER INTERPHONE
JUMPMASTER INTERPHONE TERMINAL

Figure 501C—Block Wiring Diagram for Very Late C-47B

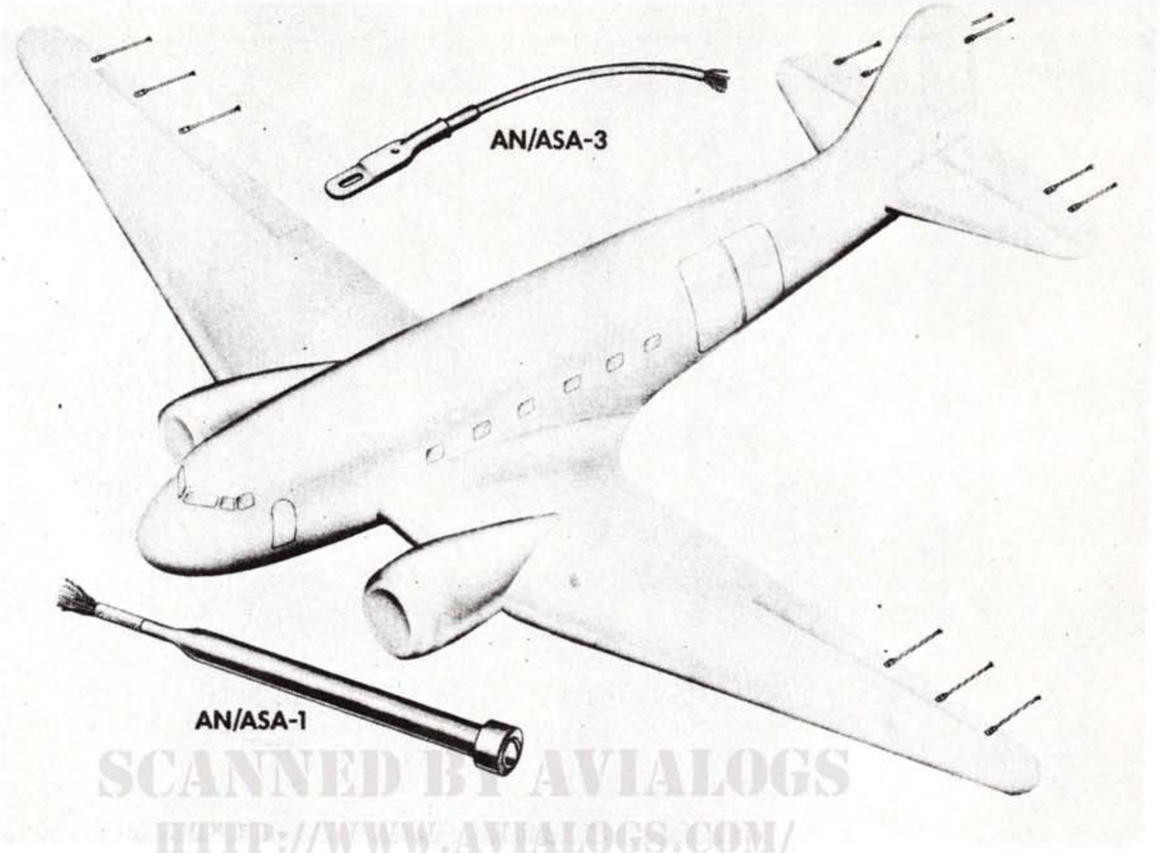


Figure 501D—Static Dischargers

aa. STATIC DISCHARGERS. *(See figure 501D.)*

(1) Twelve static dischargers, to dissipate static, are installed: two on the trailing edge of each aileron, one on the trailing edge of each wing tip, two on the trailing edge of each elevator, and two on the trailing edge of the rudder. On a few airplanes these static dischargers, AN/ASA-1, consist of an aluminum tube with a wick trailing; on later airplanes, static dischargers AN/ASA-3, the wick is protected, except on the extreme tip, by a transparent, flexible, synthetic tubing.

(2) MAINTENANCE.—Dip the wick of the dischargers in a solution of ethylene glycol or glycerine 80 per cent and water 20 per cent by volume, when it becomes dry. Flexible synthetic tubing must be kept trimmed to expose 1½ inch ± ¼ inch of wick.

bb. GENERAL (VERY LATE C-47B AIRPLANES).—Very late C-47B airplanes incorporate a re-arranged communications system, with the addition of a few new units that have not been installed in previous airplanes. Most of these radio sets are installed in a rack which is located just forward of the radio operator's position. This arrangement allows the radio operator to face forward instead of outboard as in previous airplanes. (See figures 501C, 501E and 501F.) The radio sets installed in this series of airplanes are as follows:

AN/AIC-3 INTERPHONE AND RANGE FILTER.—For communication between crew members and for operation of some radio sets.

AN/AIA-1A GLIDER INTERPHONE PROVISIONS.—For communication between the airplane and an attached glider.

AN/APN-1 RADIO ALTIMETER.—For direct measurement of altitude from the ground to the airplane.

AN/APN-2 NAVIGATION RADIO.—For navigational purposes, short range.

AN/APN-9 NAVIGATION RADIO.—For navigational purposes, long range.

AN/ARC-3 VHF COMMAND SET.—For short range communication on very high frequencies.

AN/ARC-8 LIAISON RADIO SET.—For communication from airplane to airplane or airplane to station in long range operation.

AN/ARN-5A GLIDE PATH RECEIVER.

RC-103—( ) LOCALIZER RECEIVER.—For vertical and lateral guidance in making blind landings (when used with AN/ARN-5A glide path receiver.)

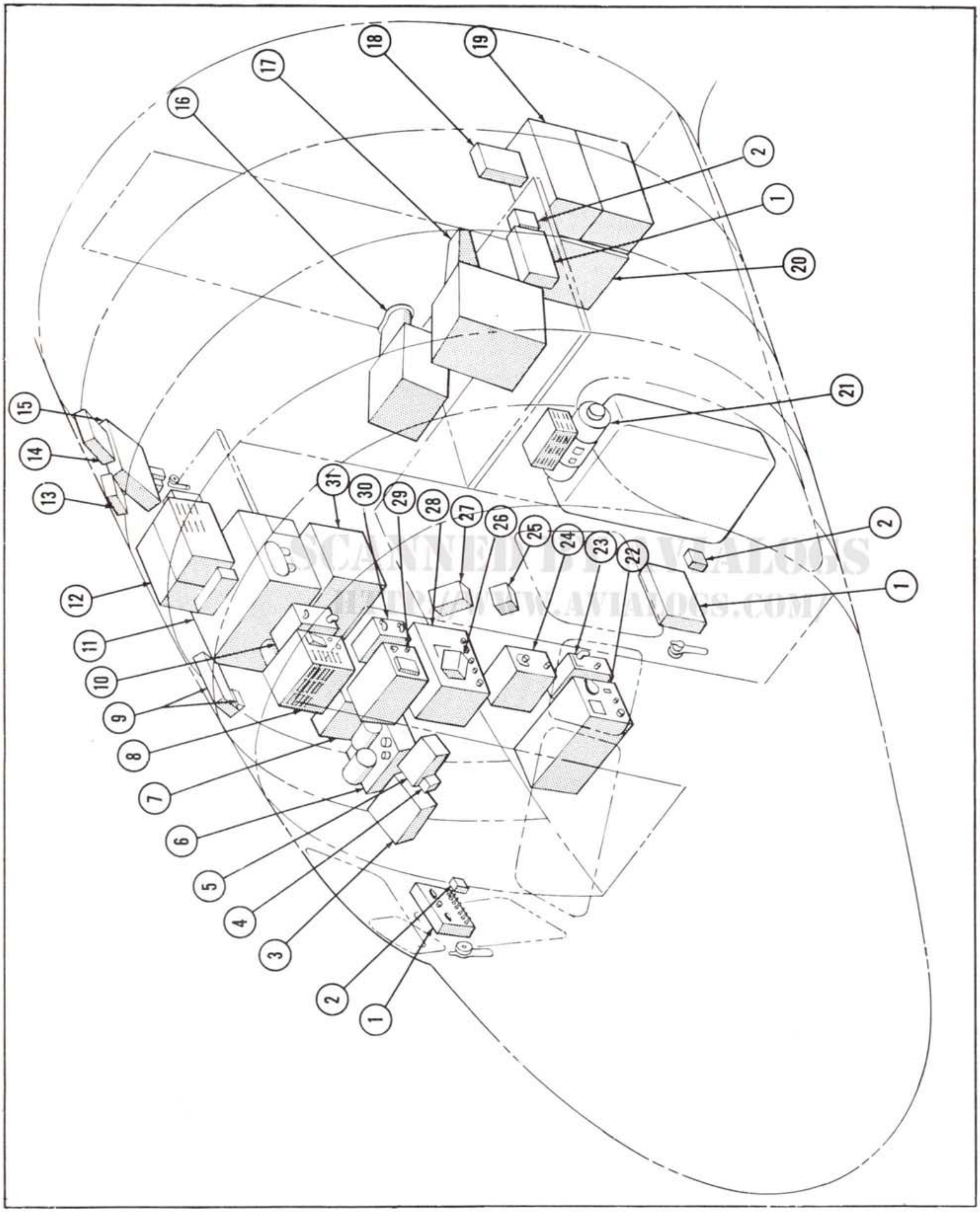

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
2
1
20
21
2
1
22
23
24
25
26
27
28
29
30
31

Figure 501E—Communication Equipment for Very Late C-47B Airplanes

KEY TO FIGURE 501E

1. Switch Box, Interphone
2. F-21/ARA-9 Filter, Interphone Range
3. C-4/ARN-7 Control Unit, Automatic Radio Compass
4. SA-80/ARC Switch, V.H.F. Command Radio
5. MN-28 Control Unit, Manual Radio Compass
6. J-68/ARC-3 Power Junction Box
7. ART-13 Power Supply, Liaison Radio
8. T-67-( )-/ARC-3 Transmitter, V.H.F. Command Radio
9. J-90 Interphone Junction Box and RE-31/U Relay
10. RC/103 Localizer Receiver, Blind Landing Radio
11. ART-13 Liaison Transmitter, Liaison Radio
12. Command Transmitter
13. Antenna Relay Unit, Command Transmitter
14. Circuit Breaker Panel
15. Radio Junction Box
16. Indicator Unit, AN/APN-2 Navigator's Radar
17. AN/APN-9 Receiver Indicator, Navigator's Radar
18. Control Unit, APN-2, Navigator's Radar
19. APN-2 Transmitter Rec, Navigator's Radar
20. R-5/ARN-7 Receiver, Automatic Radio Compass
21. PU-16 Inverter
22. MN-26 Radio Compass, Manual Radio Compass
23. BC-1333 Receiver, Marker Beacon
24. AM-26 Interphone Amplifier
25. SCR-274 Control Unit, Command Transmitter
26. BC-732 Control Unit, Blind Landing Radios
27. Remote Control Unit, Liaison Radio
28. AN/APN-1 Radio Altimeter
29. R-77-( )-/ARC-3 Receiver, V.H.F. Command Radio
30. AN/ARN-5 Glidepath Receiver, Blind Landing Radios
31. BC-348 Liaison Receiver, Liaison Radio

AN/ARN-7 AUTOMATIC RADIO COMPASS.—For navigational purposes.

AN/ARN-11 MANUAL RADIO COMPASS.—For navigational purposes.

RC-193—( ) MARKER BEACON RECEIVER.—For navigation and landing.

SCR-274N MF COMMAND SET.—For communication from airplane to airplane or airplane to station in short range operation.

SCR-695 IDENTIFICATION RADIO.—For recognition purposes.

AN/ASA-3 STATIC DISCHARGERS.

Information concerning radio sets of this series not previously installed on C-47 airplanes is given as follows:

(1) AN/AIC-3 INTERPHONE AND RANGE FILTER. *(See 2, figure 501G; 2, figure 501D; and 3, figure 501H and 501J.)*

(a) DESCRIPTION.—This interphone equipment is an improved type of intercommunication system between crew members. A control box is provided at the pilot, co-pilot, navigator, and radio operator positions. Each control box contains jacks for a microphone and a headset; also provisions are made for emergency operation of one headset. Nine toggle switches permit any combination of interphone, transmitter or receiver listening desired. The range filter control (1, figure 501K) is located on the left-hand side of the box and permits voice or CW reception of the automatic radio compass (AN/ARN-7) or the manually operated radio compass (AN/ARN-11), whichever is desired. The range filter, F-21/ARA-9, is a separate unit and is located near the control box.

The microphone control is located on the opposite side of the box. A junction box (7, figure 501L), J-90/AIC-3, is located immediately above the radio rack between stations $117\frac{3}{8}$ and 136. Leads from the four control boxes plug into this junction box; other wire bundles go to the receivers, transmitters, and the power supply. Connection is also made in this junction box to the interphone relay and an amplifier, AM-26/AIC, which provides interphone communication between the main cabin, the crew, and an attached glider.

(b) REMOVAL.

1. CONTROL BOX (C-166/AIC-3).

a. Disconnect and remove headset and microphone.

b. Loosen and remove the plug from the control box.

c. Loosen the four captive screws, one at each corner on the front of the box, and remove the front part of the control box. This part contains the vacuum tube, the switches, and all of the control mechanism.

d. Remove the four screws and nuts holding the back plate of the control box to the airplane. Remove the back plate and the control box from the airplane.

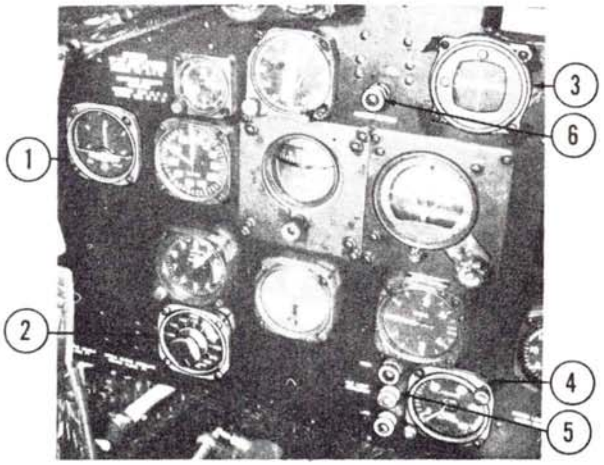


Figure 501F—Pilot's L.H. Instrument Panel Radio Equipment for Very Late C-47B Airplanes

1. Left Right Indicator, Manual Radio Compass
2. Altitude Limit Switch, Radio Altimeter
3. I-101-( ) Indicator Assembly, Blind Landing Radios
4. Alititude Indicator, Radio Indicator
5. Altitude Limit Lights, Radio Indicator
6. Indicator Lamp, Marker Beacon

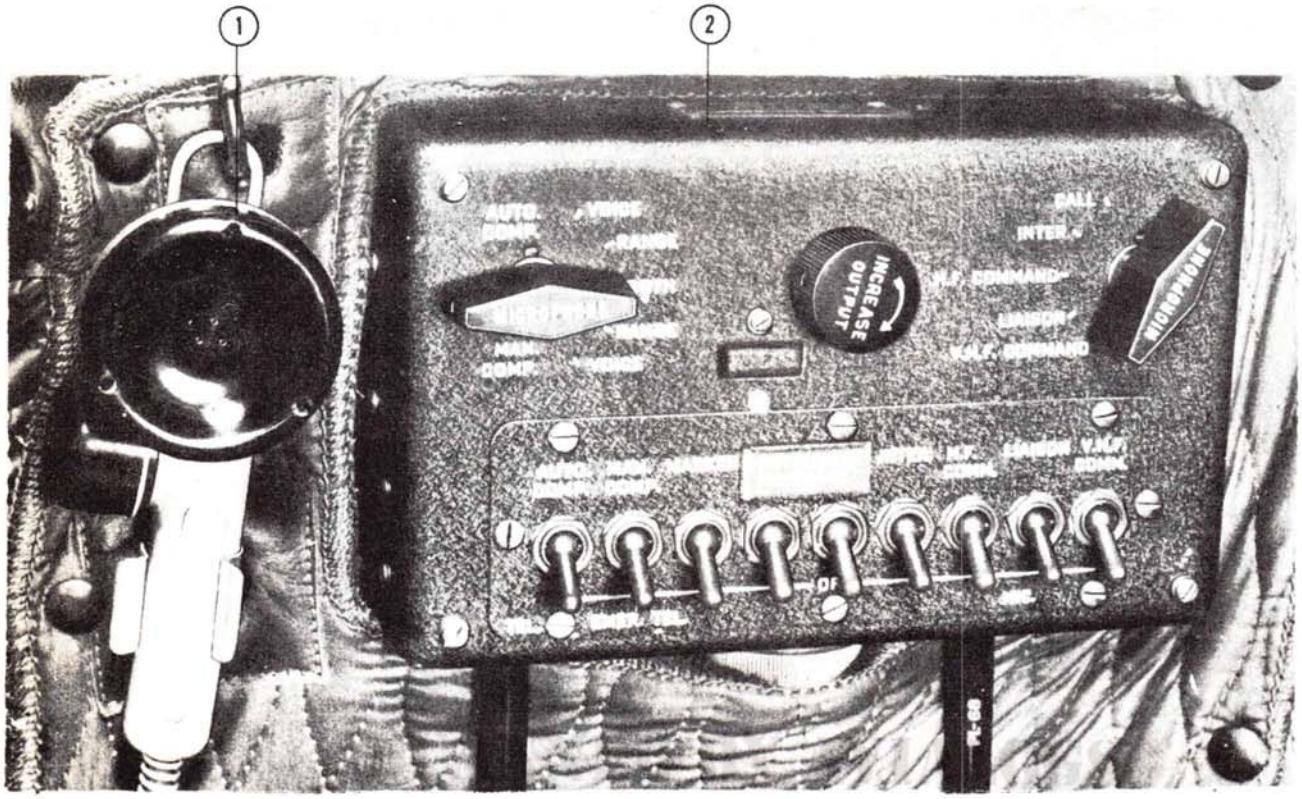


Figure 501G—Copilot's Radio Equipment for Very Late C-47B Airplanes

1. Microphone 2. Copilot's Interphone Switch Box

2. INTERPHONE JUNCTION BOX (J-90/AIC-3).

a. Release the two Dzus fasteners and remove the cover.

b. Loosen and remove the four screws, nuts, and washers holding the box to stations 117⅜ and 136½. Remove the box from the airplane.

3. FILTER UNIT (F-21/ARA-9).

a. Remove the four screws holding the front cover in place and remove the cover, exposing a terminal strip.

b. Disconnect the wires from the terminal strip. Tag each wire so that a correct installation can be made.

c. Loosen and remove the four screws holding the filter box to the airplane. Remove the filter box and the cover from the airplane.

4. INTERPHONE AMPLIFIER, AM-26( )/AIC. *(See 7, figure 501M.)*

a. Cut and remove the safety wire from the clamp at the front of the amplifier.

b. Disconnect the plug from the amplifier and move it out of the way.

c. Loosen the clamp at the front of the amplifier.

d. Slide the amplifier out toward the aisle.

(c) INSTALLATION.—The installation is substantially the same as the removal procedure preceding.

(d) MAINTENANCE AND ADJUSTMENTS.—Refer to section X on service inspections for communications equipment. Only qualified personnel shall attempt maintenance on this equipment.

(2) AN/AIA-1A GLIDER INTERPHONE PROVISIONS.—Provisions have been made for glider interphone communication on very late C-47B airplanes. Connection is made from the interphone amplifier AM-26( )/AIC, located in the radio rack, to the junction box J-90/AIC, to the plug at the tail cone. An additional phone station, which connects into this line, is located at the aft wall of the main cargo compartment. No maintenance or adjustment of this system is necessary.

(3) AN/APN-9 RADAR SET.

(a) DESCRIPTION.—AN/APN-9 radar set is airborne navigational equipment composed of receiver-indicator R-65/APN-9 (4, figure 501H) equipped with a detachable visor, the necessary cables, plugs, and mounting. It receives, amplifies and detects "LORAN" signals and displays them on a screen. A lens and visor magnify and clarify the screen image so that accurate readings may be taken. These readings, when properly used with the "LORAN" charts, will

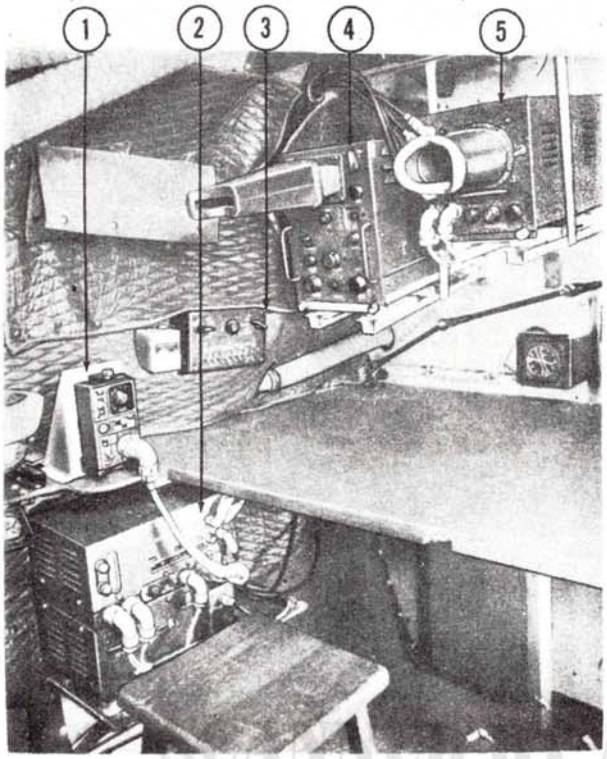


Figure 501H—Navigator's Radio Equipment for Very Late C-47B Airplanes

1. Control Unit, AN/APN-2 Navigator's Radar
2. AN/APN-2 Transmitter Receiver, Navigator's Radar
3. Interphone Switch Box
4. AN/APN-9 Receiver Indicator, Navigator's Radar
5. Indicator Unit, AN/APN-2 Navigator's Radar

determine the position of the airplane or enable the operator, under certain conditions, to fly the airplane along a plotted course. The 115-volt alternating current power for this set comes through a circuit breaker in the main junction box.

(b) REMOVAL.

1. Disconnect the power plug.

2. Disconnect the antenna.

3. Loosen the knurled thumbnuts at the front of the shock mounting until they fall free.

4. Slide the receiver-indicator aft and out.

(c) INSTALLATION.

1. Carefully place the receiver-indicator in its shock mount frame.

2. Be sure the two spring plungers which protrude from the back of the receiver-indicator case are through the holes located at the back of the shock mount frame.

3. Tighten the two knurled thumb nuts on the front of the shock mount frame to the two brackets on the front of the receiver-indicator.

4. Be sure that the receiver rides securely on the shock mount and that nothing prevents the shock mount from functioning correctly.

5. Connect the power plug and the antenna cable.

(d) MAINTENANCE.—The maintenance of this receiver, including adjustment, requires special instructions. Personnel not familiar with radar equipment of this sort should not tamper with or attempt adjustment of this receiver.

(4) AN/ARC-8 MF LIAISON SET.—The AN/ARC-8 liaison radio equipment replaces the SCR-287—( ) liaison radio equipment on very late C-47B airplanes. The AN/ARC-8 equipment includes the following units:

T-47A/ART-13 TRANSMITTER.
DYM-17( )/ART-13A DYNAMOTOR.
C-87( )/ART-13 REMOTE CONTROL UNIT.
BC-348-E RECEIVER.
AN/ARA-4 ANTENNA ASSEMBLY.

Operational and maintenance handbooks for the receiver and transmitter are also included.

(a) T-47A/ART-13 TRANSMITTER. (*4, figure 501L.*)

1. DESCRIPTION.—The principal difference in the AN/ARC-8 liaison set and those in previous installation is in the transmitter. The T-47A/ART-13 transmitter permits automatic shifting of the transmission frequency from the pilot's or radio operator's

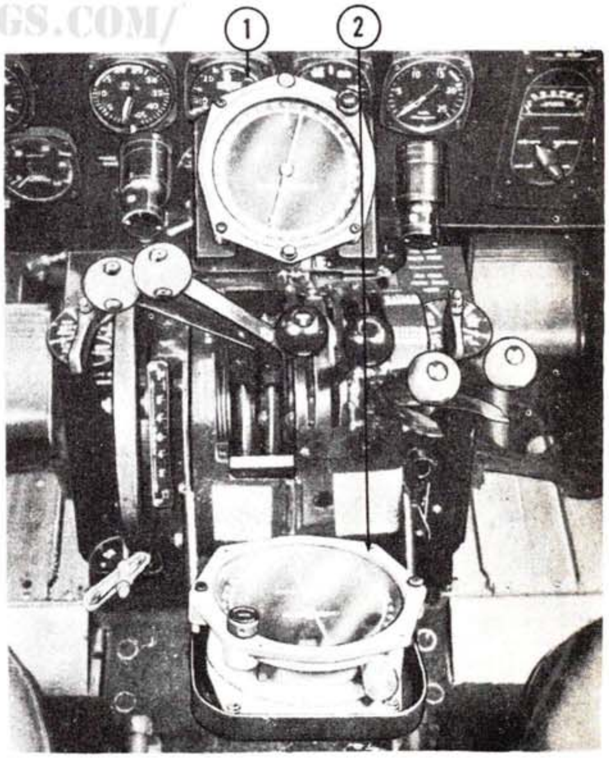


Figure 501J—Radio Compass Indicators for Very Late C-47B Airplanes

1. ID-65-( )/ARN-7 Bearing Indicator, Automatic Radio Compass
2. MN-40-E Azimuth Indicator, Manual Radio Compass

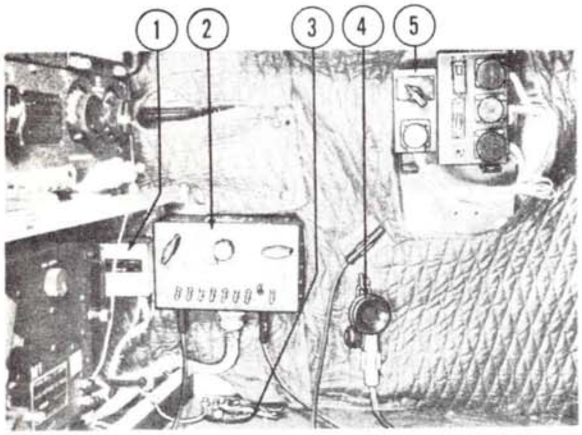


Figure 501K—Radio Operator's Equipment (Looking Outboard) for Very Late C-47B Airplanes

1. F-21/ARA-9 Filter, Interphone Range
2. Interphone Box
3. C-W Key
4. Microphone
5. Control Assembly Selector and Power, SCR-695 Identification Radio

position. This is accomplished by means of an electrically driven autotune mechanism inside the transmitter case. Automatic tuning of eleven preset frequencies is possible, with ten of these being in the frequency range of 2000 kc to 18,100 kc. The remaining setting is in the frequency range of 200 kc to 1500 kc.

CW, MCW, and voice modulated types of emission are available with this transmitter. Keying speeds up to 30 words per minute may be used when operating with CW and MCW emission. The audio system is capable of modulating the carrier (100 watts nominal) at least 90 percent for MCW or voice emission.

Two power levels are available with this transmitter. Power is automatically reduced to one-half the full power by a pressure operated relay when an altitude of approximately 25,000 feet is reached.

2. REMOVAL

WARNING

Shut off the dynamotor and open the main switch in the power supply circuit before removing this transmitter.

a. Remove all power and control plugs.

b. Remove the plexiglass shield and disconnect all antenna and ground connections.

c. Remove the safety wire from the two knurled knobs at the front of the transmitter shock mounting. Loosen the knobs until they fall free.

d. Slide the transmitter slightly aft, then lift out toward the aisle.

3. MAINTENANCE.—The maintenance of this transmitter requires special attention by qualified personnel familiar with the operation of radio equipment. Unqualified personnel should not attempt to make adjustments or repairs on this transmitter.

4. INSTALLATION.—The installation is substantially the same as the removal procedure preceding.

WARNING

Do not turn the dynamotor on until the installation of this transmitter is complete.

(b) DY-17( )/ART-13A DYNAMOTOR.

1. DESCRIPTION. *(See 7, figure 501E.)*—The dynamotor is located on the third shelf of the radio rack and on the outboard side. It provides power for the AN/ARC-8 radio, and has an output of 28 volts direct current and an output of 750 volts alternating current.

2. REMOVAL.

WARNING

Turn ART-13 control switch "OFF" before removing dynamotor.

a. Remove AN/APN-1 transceiver.

b. Disconnect two electrical plugs on inboard side of dynamotor.

c. Loosen the two knurled thumb nuts at inboard end of base.

d. Slide dynamotor inboard and remove.

3. MAINTENANCE.—Only qualified personnel shall attempt any maintenance of the dynamotor.

4. INSTALLATION.—The installation procedure is substantially the same as the removal procedure.

WARNING

Do not turn ART-13 control switch "ON" before installation is completed.

(c) C-87( )/ART-13 REMOTE CONTROL UNIT.

1. DESCRIPTION. *(See 1, figure 501N.)*—The remote control unit is located above the pilot's head. It permits selection of any one of eleven frequencies, voice, CW, or MCW. It is equipped with a key (for MCW or CW emission) and a microphone jack.

2. REMOVAL.

a. Turn the battery master switch and ground power switch "OFF".

b. Disconnect the cable connector plugs.

c. Loosen the four retaining bolts.

d. Remove unit.

3. MAINTENANCE.—Only qualified personnel shall attempt any maintenance of this unit.

4. INSTALLATION.—The installation procedure is substantially the same as the removal procedure.

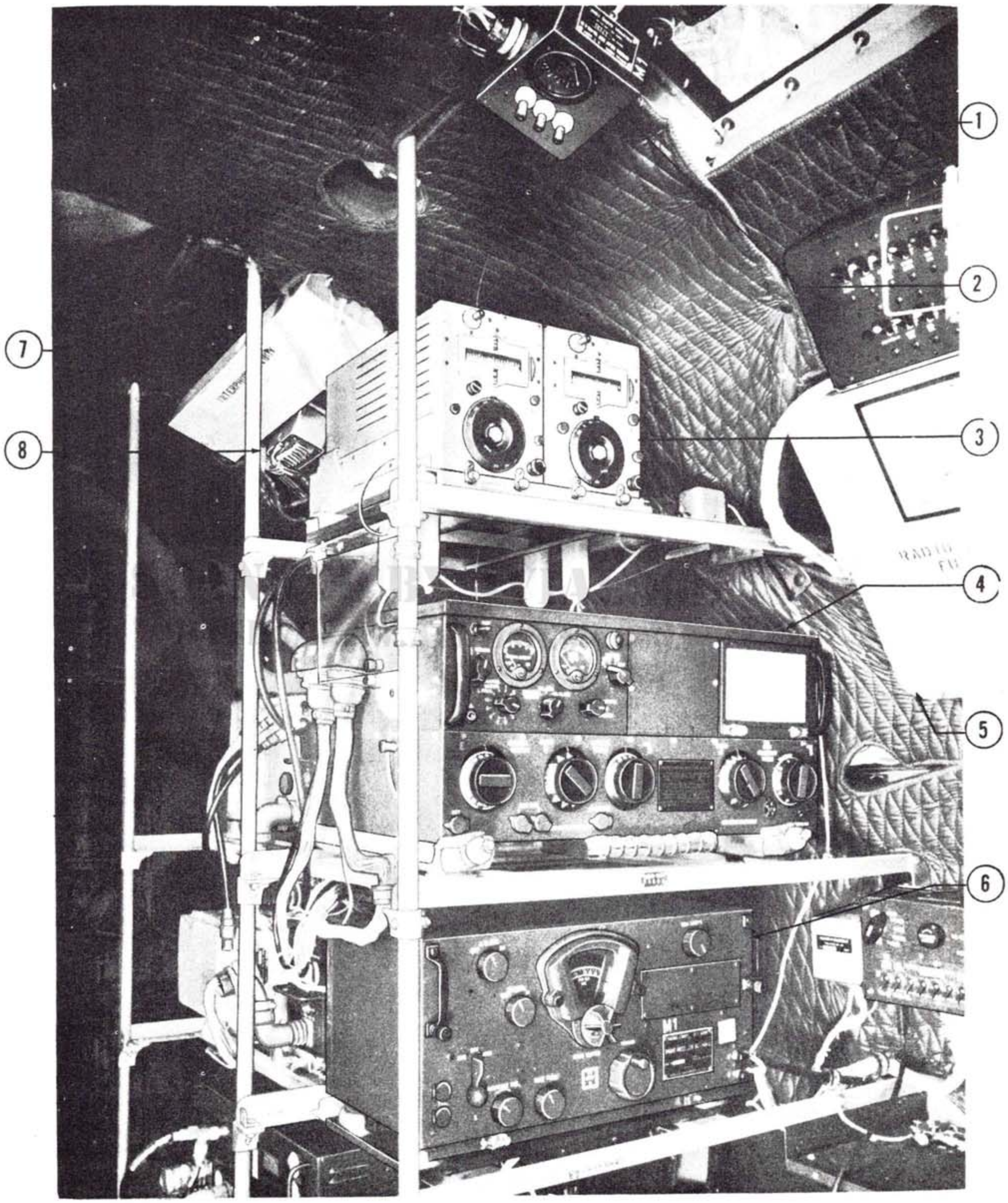


Figure 501L—Radio Operator's Equipment (Looking Forward) for Very Late C-47B Airplanes

1. Circuit Breaker Panel
2. Antenna Relay Unit, Command Transmitter
3. Command Transmitter
4. AN/ART-13 Liaison Transmitter, Liaison Radio
5. Radio Junction Box
6. BC-348 Liaison Receiver, Liaison Radio
7. J-90 Interphone Junction Box
8. RE-31/U Relay

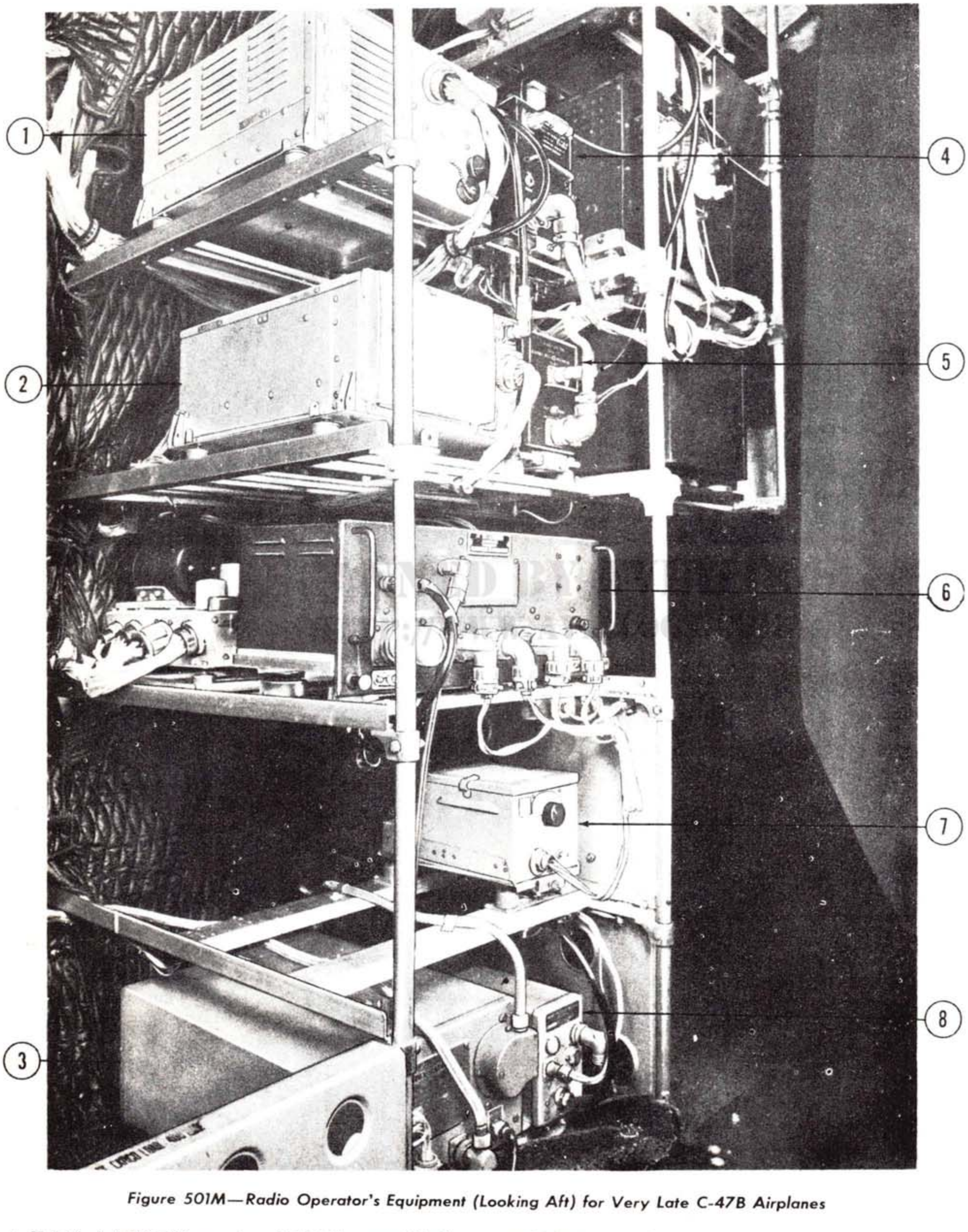


Figure 501M—Radio Operator's Equipment (Looking Aft) for Very Late C-47B Airplanes

1. T-67-( )-/ARC-3 Transmitter, V.H.F. Command Radio
2. R-77-( )-/ARC-3 Receiver, V.H.F. Command Radio
3. MN-26-B Radio Compass, Manual Radio Compass
4. RC-103 Localizer Receiver, Blind Landing Radios
5. AN/ARN-5 Glide Path Receiver, Blind Landing Radios
6. AN/APN-1 Radio Altimeter
7. AM-26 Interphone Amplifier
8. BC-1333 Receiver, Marker Beacon

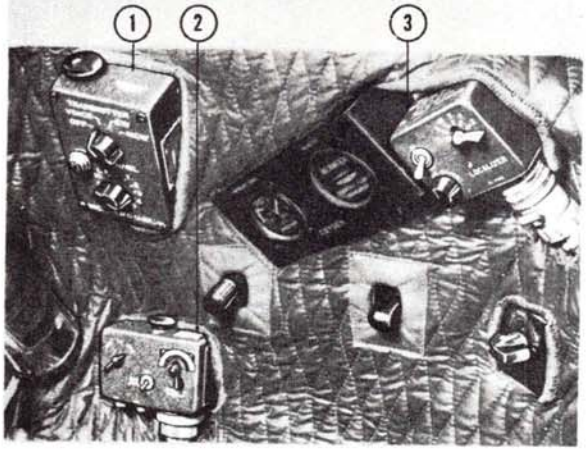


Figure 501N—Pilot's Control Boxes for Very Late C-47B Airplanes

1. Remote Control Unit, Liaison Radio
2. SCR-274 Control Unit, Command Transmitter
3. BC-732 Control Unit, Blind Landing Radios

(d) BC-348-E RECEIVER. *(See 6, figure 501L.)*—This receiver is located on the second shelf of the radio rack forward of the radio operator's seat.

(e) AN/ARA-4 ANTENNA ASSEMBLY. *(See figure 501P.)*—This antenna extends from the fuselage exterior over the radio operator's seat to the right horizontal stabilizer tip.

(5) AN/ARC-3 VHF COMMAND SET.

(a) T-67 ( )/ARC-3 TRANSMITTER.

1. DESCRIPTION. *(See 1, figure 501M.)*—This transmitter is located on the upper forward shelf of the radio rack. This high frequency transmitter is for short range voice communication. It is equipped with a mounting base.

2. REMOVAL.

WARNING

Turn control unit switch to "OFF" position before attempting removal.

a. Disconnect coaxial cables and electrical connector plugs.

b. Open the snap fasteners located on each side of the base.

c. Remove transmitter by lifting up and inboard.

3. MAINTENANCE.—Only qualified personnel shall attempt any maintenance of this transmitter

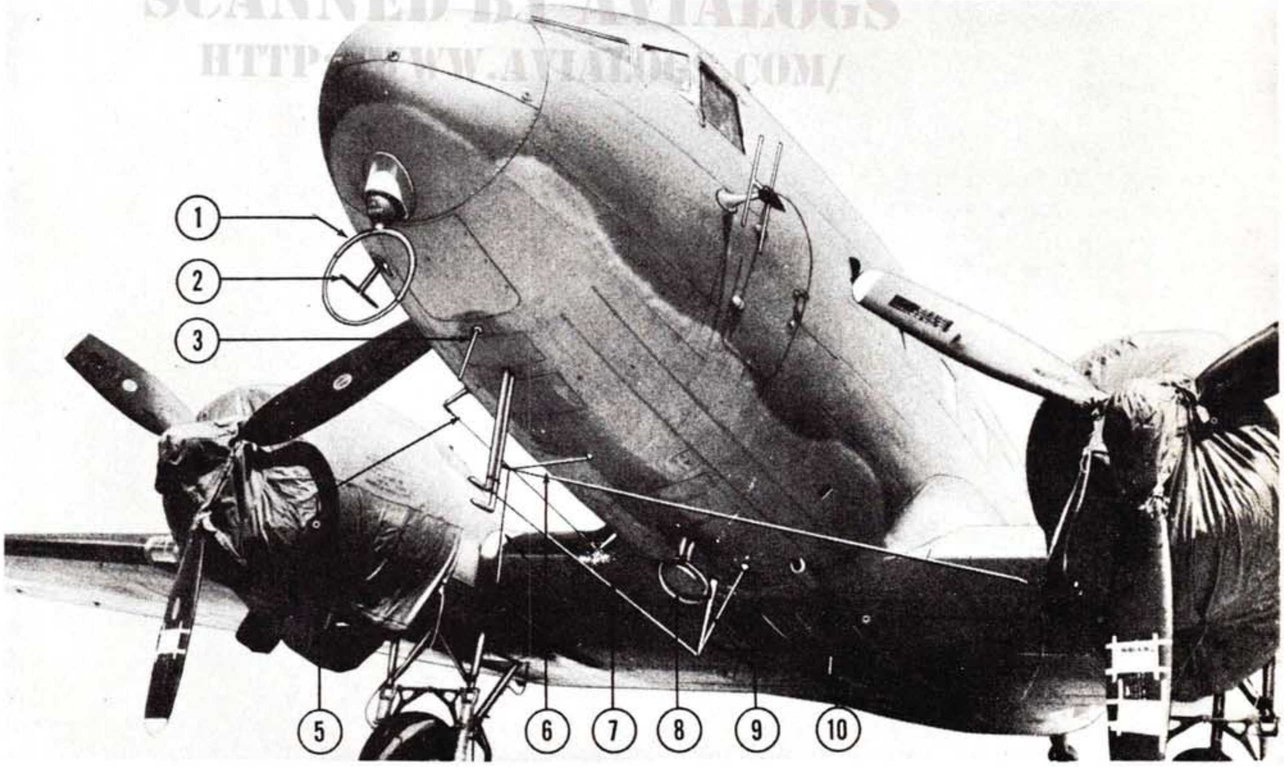


Figure 501P—Forward Antennas for Very Late C-47B Airplanes

1. MN-26-C Loop Antenna, Manual Radio Compass
2. Antenna (Transmitting), AN/APN-1 Radio Altimeter
3. Antenna (Transmitting), AN/APN-2 Navigator's Radar
4. Antenna (Receiving), AN/APN-2 Navigator's Radar
5. Antenna, Marker Beacon
6. Sense Antenna, Manual Radio Compass
7. Antenna, ARN-7 Automatic Radio Compass
8. LP-21-( ) Loop Antenna, Automatic Radio Compass
9. AN-104-B Antenna, V.H.F. Command Radio
10. Antenna (Receiving), AN/APN-1 Radio Altimeter

4. INSTALLATION.—The installation procedure is substantially the same as the removal procedure.

(b) R-77-A/ARC-3 RECEIVER.

1. DESCRIPTION. *(See 2, figure 501M.)*—This receiver is located on the fourth shelf of the radio rack. It is used for reception of very high frequency short range communication.

2. REMOVAL.

WARNING

Turn control unit switch in "OFF" position before attempting to remove this receiver.

a. Disconnect coaxial cables and electrical connector plugs.

b. Open snap fasteners on each side of base.

c. Remove receiver by lifting up and inboard.

3. MAINTENANCE.—Only qualified personnel shall attempt maintenance of this receiver.

4. INSTALLATION.—The installation procedure is substantially the same as the removal procedure.

(c) J-68-( )/ARC-3 POWER JUNCTION BOX.

1. DESCRIPTION. *(See 6, figure 501E.)*—This unit consists of two dynamotors and one control box. It is located on the third shelf of the radio rack on the outboard side.

2. REMOVAL.

WARNING

Place ARC-3 circuit breaker (located in radio compartment) in "OFF" position before attempting to remove this unit.

a. Disconnect all electrical connector plugs.

b. Open snap fasteners located on each side of base.

c. Remove unit by lifting up and forward.

3. MAINTENANCE.—Only qualified personnel shall attempt maintenance on this power junction.

4. INSTALLATION.—The installation procedure is substantially the same as the removal procedure.

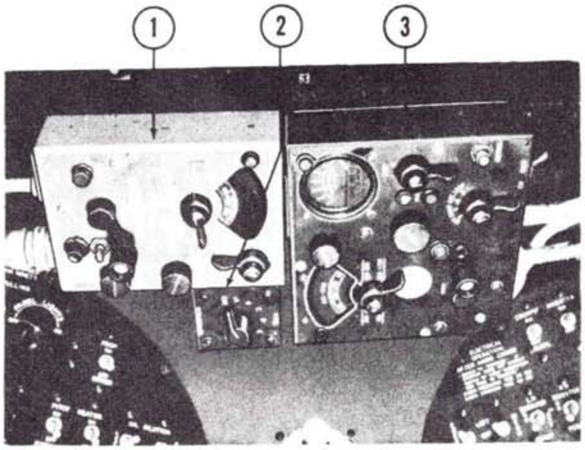


Figure 501Q—Pilots' Compartment Control Boxes for Very Late C-47B Airplanes

1. MN-28 Control Unit, Manual Radio Control
2. SA-80/ARC Switch, V.H.F. Command Radio
3. C-4/ARN-7 Control Unit, Automatic Radio Compass

(d) SA-80/ARC CONTROL BOX SWITCH ASSEMBLY.

1. DESCRIPTION. *(See 2, figure 501Q.)*—The control box switch assembly is located in the pilot's compartment above the ignition switches. This switch allows the pilot to turn the receiver on or off and to select any one of several frequencies for receiving or transmitting.

2. REMOVAL.

WARNING

Place ARC-3 circuit breaker (located in radio compartment) in "OFF" position before attempting to remove this unit.

a. Remove four cover screws.

b. Disconnect wires.

c. Remove four box mounting screws.

3. MAINTENANCE.—Only qualified personnel shall attempt maintenance on this unit.

4. INSTALLATION.—The installation procedure is substantially the same as the removal procedure.

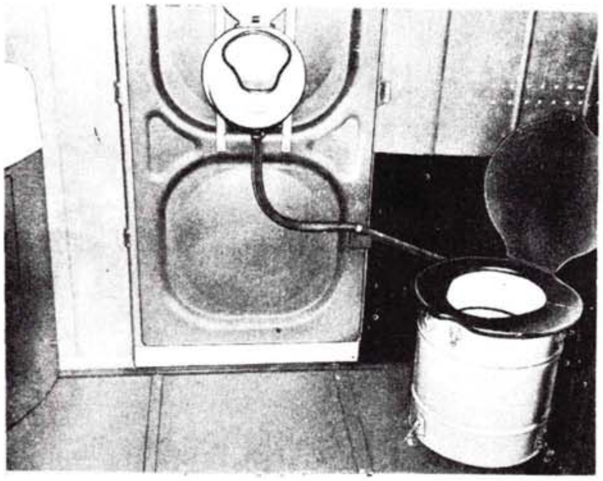


Figure 502—Lavatory Compartment

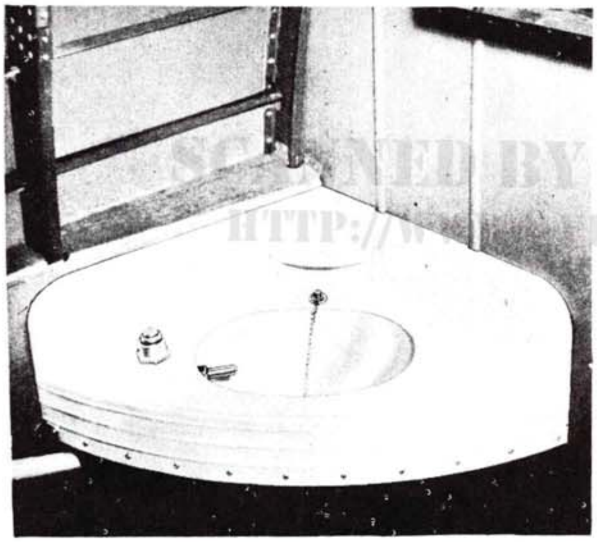


Figure 503—Wash Basin

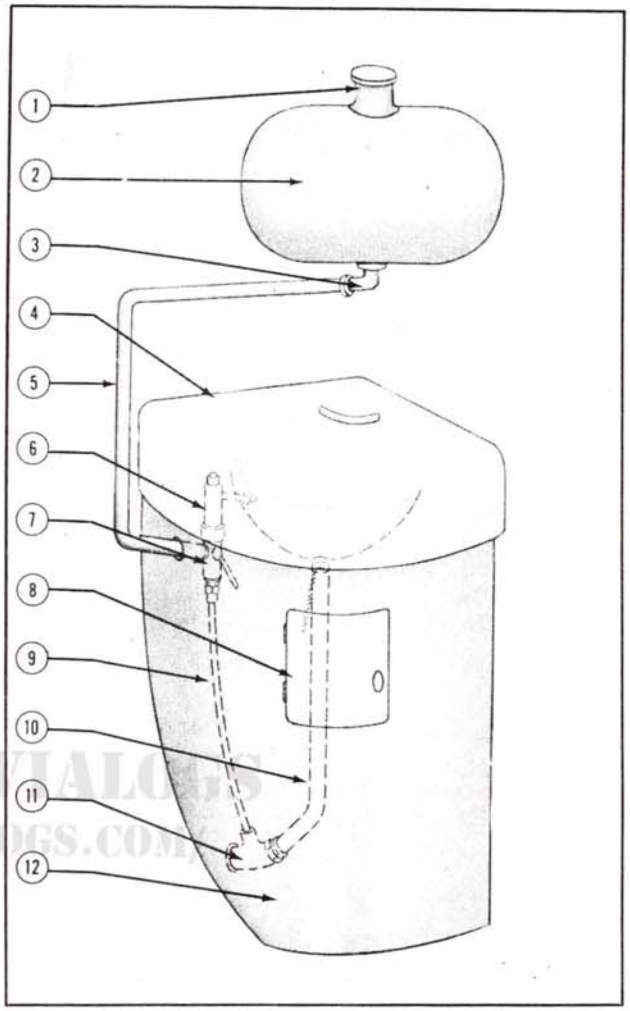


Figure 504—Wash Basin and Cabinet

1. Filler Neck and Cap
2. Tank
3. Elbow
4. Wash Basin
5. Supply Line
6. Faucet
7. Parker Plug Hand Drain Valve
8. Cabinet Door
9. Tank Drain Line
10. Wash Basin Drain Line
11. Drain Tee
12. Wash Basin Cabinet

16. FURNISHINGS.

a. GENERAL.—This paragraph is divided into three parts: personnel accommodations, emergency accommodations, and miscellaneous equipment. Personnel accommodations include the lavatory and its fixtures, flooring, carpeting, fuselage lining, seats and tables, and the drinking water provisions. Emergency accommodations include emergency exits, first aid kits, hand fire extinguishers, safety belts and rings, blackout curtains, folding ladder, and life rafts. Miscellaneous equipment includes the cabin entrance step, starter hand crank and gear box, cargo door handle guard, engine covers, the cargo wall canvas container, exhaust flame dampeners, plug assemblies, name plates, data holders and contents, tool kits, auxiliary flooring, dust excluder assemblies, drop message bag, windshield defrosters, information charts, surface control locks, tail wheel guards, and blind flying hood.

b. PERSONNEL ACCOMMODATIONS.

(1) LAVATORY. *(See figure 502.)*

(a) GENERAL.—The lavatory, aft of the cargo compartment, contains a toilet in the forward right-hand corner; a toilet paper holder above and aft of the toilet; a water tank in the upper, rear, left-hand corner; a wash basin in the front, left-hand corner; a wash basin cabinet below the basin; a towel rack above and to the right of the basin; and a urinal on the main door.

(b) CHEMICAL DISPOSAL-TYPE TOILET. *(See figure 502.)*

1. DESCRIPTION. — The No. 1083 Sierra toilet consists of two units; a lavatory bowl permanently attached to the seat with a lid swinging from the seat; and an aluminum container. A large, fiber tube vents the container through the right of the fuselage.

2. REMOVAL.

a. To remove the container from the bowl, unfasten the Corbin clips and lift the bowl from the container.

b. To remove the container for cleaning, unfasten the three trunk-type fasteners holding it to the floor.

3. MAINTENANCE.—The toilet should be removed and cleaned when necessary. Refill with at least one quart of a disinfectant solution. One tablespoon of Pinoloid or equivalent is recommended to one quart of water. Pinoloid is a dark amber and translucent pine oil. It is both a deodorant and germicide. When mixed with water it becomes an emulsion. Anticorrosive, it is an ideal cleaner. At least 3 inches of the solution should be in the container when used.

(c) WATER TANK. *(2, figure 504.)*

1. DESCRIPTION. — An aluminum water tank is supported by a dural cradle bolted and riveted to the rear bulkhead. Two turnbuckles, in front of the tank and attached to the arms of the cradle, keep the tank rigid. The cylindrical tank has a 4-¼ gallon capacity, is watertight, and is covered with a half-inch of kapok airplane cloth and thread for insulation to retain heat. A filler neck and cap are on top, and an outlet at the bottom is connected to a metal tube which extends along the left of the fuselage to a Parker shut-off valve in the wash basin cabinet. The tank has been sloshed with a solution of Ashphaultum base compound to prevent corrosion.

2. REMOVAL.—To remove the tank from the cradle, release the bonding wires from the two turnbuckles and unloosen the turnbuckles. Remove the pipe underneath by unloosening the nut over the connection at the bottom and slide the tank from the arms of the cradle.

(d) WASH BASIN. *(Figure 503 and 4, figure 504.)*

1. DESCRIPTION. — The lightweight metal, Sierra wash basin is attached to the fuselage stringer at the left by three screws, and to the bulkhead in front by three screws. It has a recessed opening, preventing slopping over, and a drain nipple integral with the bowl, a No. 3 Kirkhill rubber stopper. On the lip of the basin is a Dayton No. 51 self-closing faucet. For drainage, a pipe is routed from the outlet of the basin to an outlet at the left of the fuselage. By turning the handle, the Parker valve allows drainage of the tank through another pipe to the same outlet.

2. REMOVAL.—Remove basin by disconnecting the screws holding it to the fuselage, bulkhead, and cabinet, and disconnect the piping beneath the basin.

3. MAINTENANCE. — Resand and refinish when necessary.

(e) WASH BASIN CABINET. *(Figure 502 and 12, figure 504.)*

1. DESCRIPTION.—A plywood wash basin cabinet extends from the basin to the floor. It is screwed to the basin and covers the two (basin drainage and tank drainage) pipes. A door in front gives access to the handle of the Parker valve to drain the tank. The cabinet also serves as a container for used towels and for storing the disinfectant used in the toilet.

2. REMOVAL.—Remove the cabinet by removing the screws attached at the top to the basin, at the left to a flange along the fuselage, at the right to the bulkhead, and at the bottom to a wooden flange.

(f) URINAL. *(Figure 502.)*

1. DESCRIPTION. — A lightweight, metal urinal is attached to the main door by short bolts. A small circular cover over it renders it practicable to use in proximity to the toilet. A rubber hose extends from the bottom of the urinal, along the bulkhead through the right side of the fuselage.

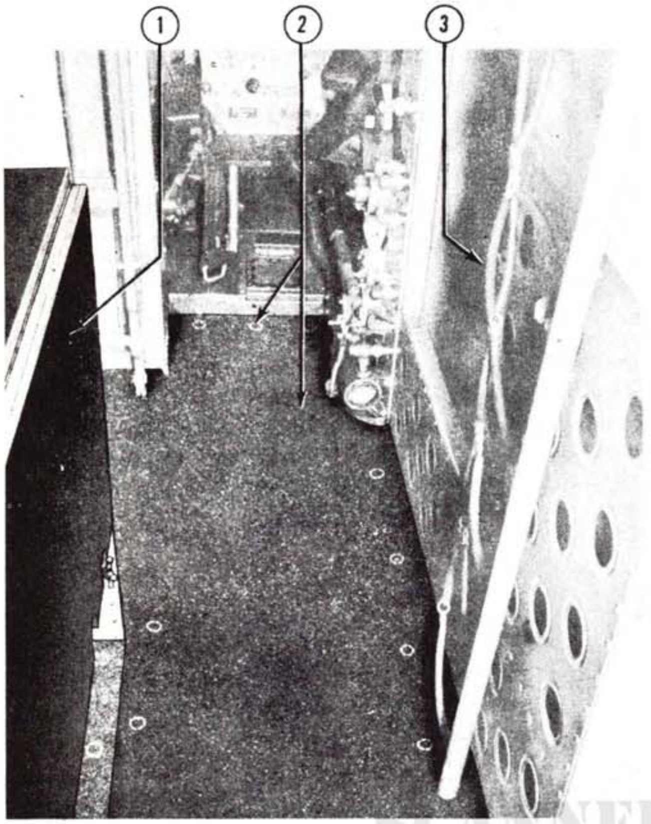


Figure 505—Navigator's Table and Carpeting

1. Aisle Extension Leaf
2. Carpeting and Dot Fastener
3. Baggage Compartment

2. REMOVAL.

a. Remove from the lip of the urinal four bolts attached to two vertical metal strips across the middle section of the door.

b. Remove four bolts, one at each end of the two strips. (In this case, the urinal would still be attached to the strips.)

(g) TOILET PAPER HOLDER.

1. DESCRIPTION.—The aluminum toilet paper holder contains folded paper rather than rolled paper to discourage waste. It is attached to the right of the fuselage by bolts.

2. REMOVAL.—Remove two bolts at each end of the holder.

(h) TOWEL RACK.

1. DESCRIPTION.—A heavy aluminum towel rack is bolted to the main lavatory bulkhead. The rack consists of a holder and frame. The holder on top telescopes into the frame and is held in place by friction, producing a rigid compact unit.

2. REMOVAL.—To remove the rack, remove two bolts at each end of the rack.

(2) PILOTS' SEATS.

(a) DESCRIPTION.—Bucket-type seats are provided for the pilot and copilot. On early C-47A airplanes, the seats are fiber, braced by a dural framework. On late C-47A and all C-47B airplanes, the seats are magnesium and the framework is braced by dural. The framework is attached to brackets, which are bolted to the floor with four bolts in each of four places. Inclined at an angle of 13 degrees, the seats are adjustable on two vertical tubes and on two horizontal tubes to accommodate pilots of varying stature. Levers at the left of the pilot and right of the copilot operate the vertical, adjusing mechanisms under the seats, and short cables at the lower right of the pilot and the lower left of the copilot operate the horizontal mechanisms just above the floor. Bungees behind the seats raise them when the levers release arms over the vertical tubes. Over each inboard horizontal tube is a support to adjust the tube rollers and stabilize the seats. Each seat is fitted with cushions and cushioned arm rests; the inboard arm rests swinging back. Seats are adaptable to B-11 or B-14 type safety belts.

(b) REMOVAL.

1. To remove seats from floor, remove bolts from rollers on horizontal tubes.

2. To remove buckets from frame, remove 16 bolts; four attached to each of four arms supporting vertical tubes.

(3) NAVIGATOR'S TABLE.
(Figures 492 and 619.)

(a) DESCRIPTION.—A hollow plywood table extends from the navigator's chair to the bulkhead aft of the small cargo door and from the left side of the fuselage, across the aisle to the radio compartment. It is bolted to a flange which is riveted to a stringer on the left side of the fuselage. At the rear end (forward part of airplane) it rests on supports attached to the bulkhead. The table folds along the left side of the aisle. If extended across the aisle it is attached, at the front end, to the radio table by hand screws, and at the rear end, to the wall of the baggage compartment. It is supported at the aisle by a leg bolted through a bracket to the floor.

(b) REMOVAL.—To remove, remove bolts from flange and bulkhead supports.

(4) RADIO OPERATOR'S TABLE. *(Figure 497.)*

(a) DESCRIPTION.—A narrow plywood table in a metal frame is held at the left to the baggage compartment by heavy metal braces underneath. The right side is bolted to a dural flange riveted to the bulkhead. The rear of the table clears the right of the fuselage and the front consists of a small, folding leaf, the only part of the table not covered with radio equipment.

(b) REMOVAL. — First, remove equipment on table. To remove table, remove bolts from braces and bolts to flange.

(5) RADIO OPERATOR'S CHAIR. *(Figure 475.)*

(a) DESCRIPTION. – A light, metal, swivel chair rests in front of the radio operator's table. It swivels through a 180-degree angle and may be locked at any of four points through this angle by a locking pin beneath the seat. A screw through each of the four legs secures it to the floor channels. The seat is equipped with a safety belt.

(b) REMOVAL.

1. To remove seat, unscrew each of the four screws.

2. To remove swivel mechanism, remove bolts.

(6) NAVIGATOR'S STOOL. *(Figure 619.)*

(a) DESCRIPTION.–A small, wooden stool in front of the navigator's table is held down by a screw through each of four brackets; two at the floor, and two at the compass receiver guard. The bulkhead in back may serve as a back-rest.

(b) REMOVAL.

1. Remove screws from the brackets at the base of each leg.

2. Remove bolts in brackets.

(7) PILOT'S RELIEF TUBES. – Conical, metal tubes under the pilot's and copilot's seats may be pulled just forward of the seats. The tubes are vented to the bottom of the fuselage by rubber tubing.

(8) FLOORING.

(a) GENERAL. – There are four sections of flooring: the pilots' compartment; between the pilots' compartment and cabin section; the cabin and cargo section; and the lavatory.

(b) PILOTS' COMPARTMENT FLOORING.

1. DESCRIPTION. – The flooring in the pilots' compartment consists of three aluminum panels on either side and one in front of the fire extinguisher plate. The aft panels, extending from the bulkhead to under the pilot's and copilot's seats, are light and are held down by screws. The middle panels under the seats are heavy and are held down by screws. The forward panels are corrugated on the under side for strength and are fastened by hand clamps for easy removal. The small panel, between the forward panels and in front of the fire extinguisher plate, is corrugated on top and is also held by hand clamps for easy removal. All these panels are supported on heavy floor beams, four surrounding the fire extinguisher plate.

2. REMOVAL.

a. REAR PANELS. – Remove attaching screws (No. 530-8-8).

b. CENTER PANELS. – Remove attaching screws (No. 530-8-8).

c. FRONT PANELS.–Turn hand clamps.

d. SMALL FRONT PANEL. – Turn hand clamps.

(c) FLOORING BETWEEN PILOTS' COMPARTMENT AND CABIN.

1. DESCRIPTION.–This section, which includes the companionway, the right side of the small cargo door, and the navigator's baggage, and radio compartments, is covered with panels of half-inch plywood. The flooring is attached to the metal beams through nut plates with AN526-10-22 screws.

2. REMOVAL. – To remove panels, remove screws.

Note

Carpet must be removed.

(d) CABIN AND CARGO SECTION FLOORING.

1. CABIN SECTION FLOORING. *(6, figure 508.)*

a. DESCRIPTION.–The cabin section, or slanting section from the bulkhead aft of the radio compartment to the main cargo door, is covered with panels of corrugated aluminum. The companionway panels consist of smooth sheets of aluminum over the corrugation; the side panels in the vicinity of the seats consist of only the corrugation. All panels are held to the beams by AN526-10-12 or 1113318-12 screws, through nut plates beneath the beams.

b. REMOVAL.–To remove panels, remove screws and lift by handles (6, figure 508) along the outboard side of the outboard panels.

2. CARGO SECTION FLOORING. *(Figure 126.)*

a. DESCRIPTION.–The cargo section, or short, horizontal section from the front of the cargo door to the lavatory, is covered with three, smooth bright aluminum panels placed lengthwise. Each panel has corrugation underneath for the required strength in that section. The three panels are held to beams by AN526-10-24 screws through nut plates beneath the beams.

b. REMOVAL.–To remove panels, remove screws.

(e) LAVATORY FLOORING. *(Figure 502.)*

1. DESCRIPTION.–This section consists of three half-inch, plywood panels running lengthwise. At the top of each panel is an eighth-inch covering of linoleum. Four rings toward the rear of the middle panel are used for either cargo tie-down or for lifting the panel. AN526-10-22 screws go through the panel, the top of the floor beam, and a nut plate beneath it.

2. REMOVAL.–To remove panels, remove screws.

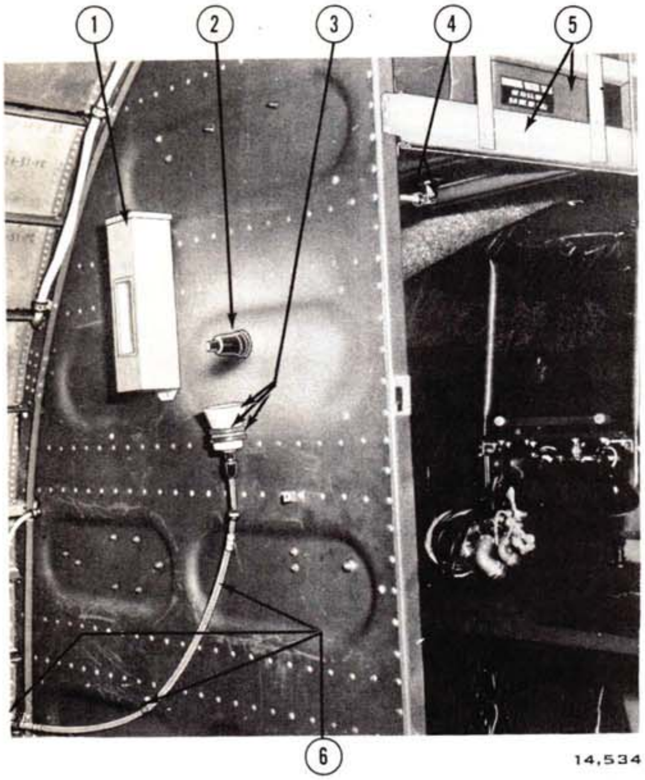


Figure 506—Drinking Water Provisions

1. Cup Container
2. Tap (Faucet)
3. Water Container, Holder and Clamp
4. Tank Drain and Supply Line
5. Tank and Cradle
6. Drain Line, Clip and Drain

(9) DRINKING WATER PROVISIONS. *(figure 506.)*

(a) DESCRIPTION.—The drinking water system consists of a water tank above the navigator's head; a line from the tank to the upper aft side of the bulkhead between the navigator and cabin sections; a water receiver beneath the tap; and a drain line routed from the water receiver, along the bulkhead and through the fuselage. Above and to the left of the tap is a drinking cup holder.

(b) WATER TANK. *(5, figure 506.)*

1. DESCRIPTION. — The 6-½ U. S. (5.4 Imperial) gallon dural tank, identical in construction with the windshield anti-icing tank, rests on a cradle above the navigator's head. Metal straps, which hold the tank rigid, are bolted at the outboard ends to each of two smaller beams, and at the inboard ends to a large beam. Strips of Adelite protect the tank from the beams. On top of the tank are a filler neck and a small vent with an inserted metal plug. Underneath is a connection for the hose.

2. REMOVAL.—To remove the tank, remove the four nuts beneath the beams at the terminals of the strap and disconnect the hose from the bottom of the tank.

(c) LINES. *(4 and 6, figure 506.)*

1. DESCRIPTION. — A thin, transparent, plastic line extends directly from the tank, through an elbow in the bulkhead, to the tap. Similarly, another such line extends from the water receiver, through rubber eyelets bolted through clamps to the bulkhead, and through the left side of the fuelage.

2. REMOVAL.—To remove lines, unscrew the lines at their terminals and disconnect clamps.

(d) TAP. *(2, figure 506.)*—A small plastic tap or faucet, incorporating a relief valve, is bolted to the fuselage. If the button is pushed, the valve is opened, allowing the water in the line to flow from the tap.

(e) WATER RECEIVER. *(3, figure 506.)*

1. DESCRIPTION.—Beneath the tap, a metal conical water receiver is held in a rubber ring with a clamp bolted to the fuselage. It serves as a funnel for excess water, flowing through the tap to the drain outlet at the left of the fuselage.

2. REMOVAL.—To remove the water receiver, unloosen bolts holding it to the fuselage and disconnect line terminal at bottom.

(f) CUP HOLDER. *(1, figure 506.)*—A light, rectangular cup holder is bolted to the bulkhead. The holder has two parts: a lid hinged to the top of the container, and the long rectangular container.

(10) FUSELAGE LINING.

(a) DESCRIPTION. — A thermo-conditioning cloth, kapok felt, lines the fuselage sides and ceiling forward of the cabin section. It also lines the sides and the front of the nose section. The cover is designed for both heat insulation and soundproofing. It is attached by durable dot fasteners which consist of a stud and a button. The stud is screwed into the metal; and the button, incorporated in the covering, clamps over it.

(b) REMOVAL.—To remove lining, snap the fastener buttons from the studs.

(11) CARPETING. *(2, figure 505.)*

(a) DESCRIPTION. — Regent green carpeting covers all of the flooring forward of the cabin to the pilots' compartment. The carpeting is a durable fabric and is attached to the wooden flooring by Scoville fasteners. The studs of the fasteners are screwed in the flooring while the buttons, having wide heads to prevent wearing through the carpeting, are fitted in the carpeting.

(b) REMOVAL.—Remove carpeting by removing fastener buttons from the studs.

c. EMERGENCY ACCOMMODATIONS.

(1) EMERGENCY EXITS. *(Figure 507.)*

(a) GENERAL.—The five emergency exits con-

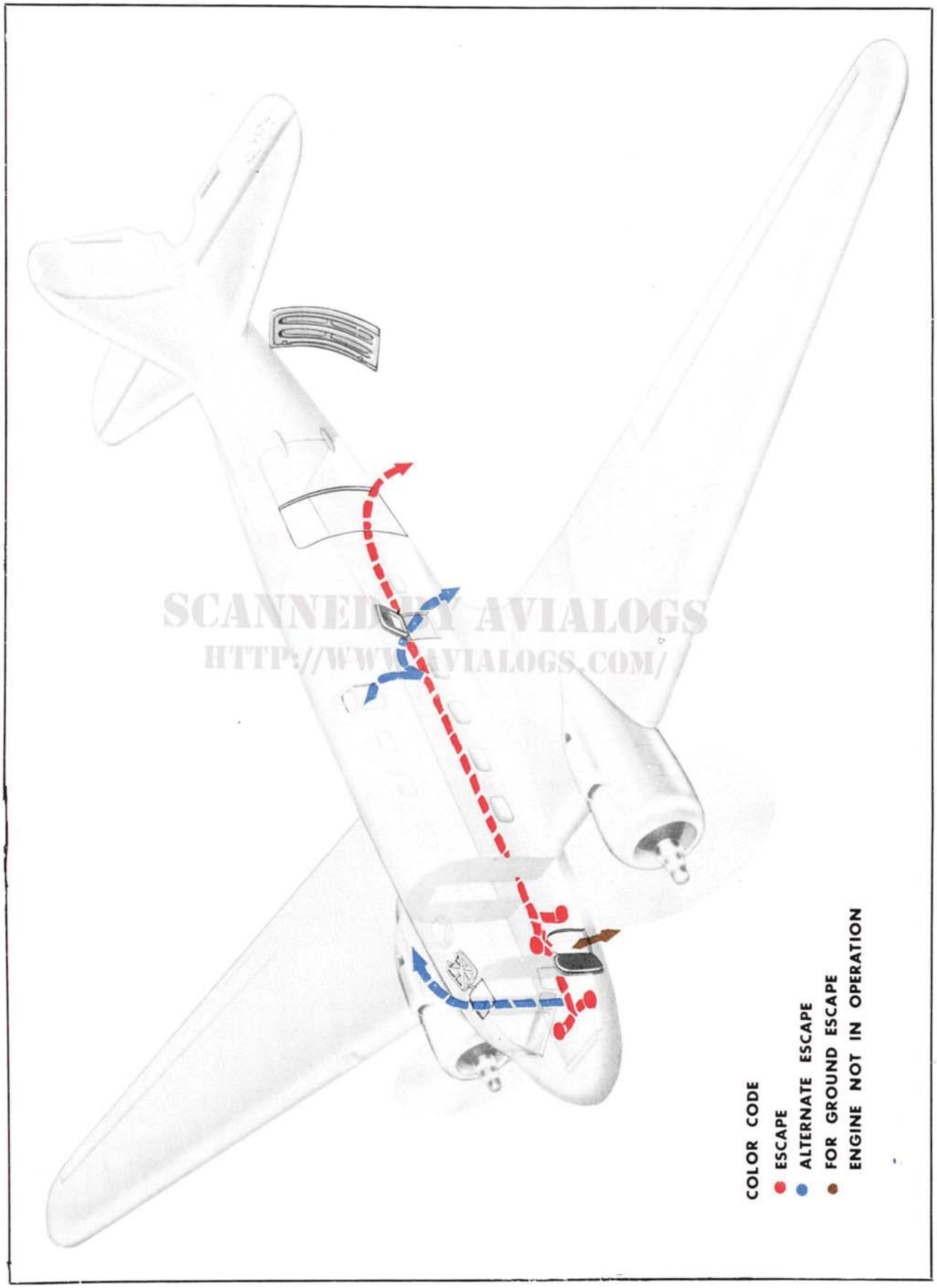

COLOR CODE
● ESCAPE
● ALTERNATE ESCAPE
● FOR GROUND ESCAPE
ENGINE NOT IN OPERATION

Figure 507—Emergency Exits

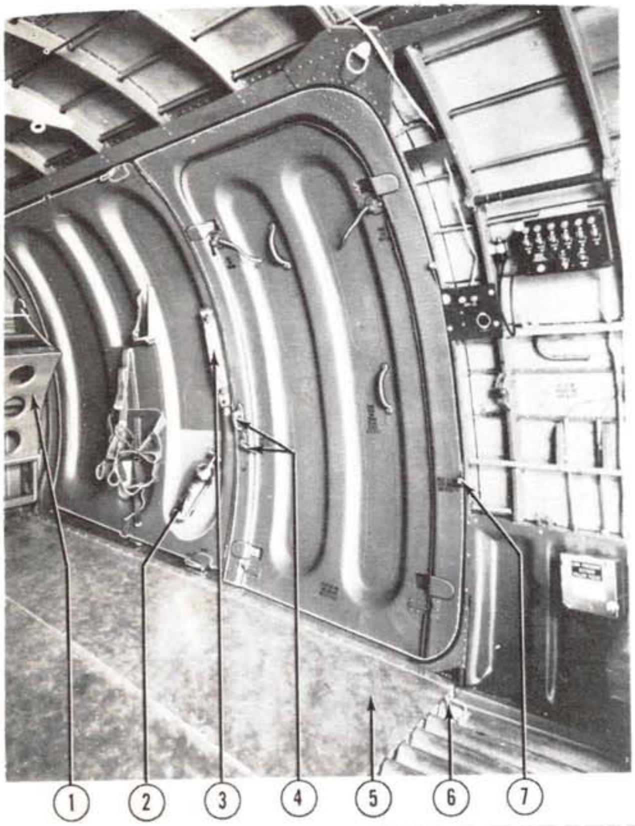


Figure 508—Inside Cargo Door

1. Entrance Step (Stowed)
2. Fire Extinguisher
3. Door Handle Guard
4. Door Latches
5. Cargo Compartment Flooring
6. Handle on Outboard Panel (Cabin Flooring)
7. Emergency Release

sist of the hatch above the pilot and copilot; the forward panel of the main cargo door; the fifth window aft on both sides of the main cargo compartment; and the small cargo door.

CAUTION

Before taking off, identify each emergency exit and its intended use.

(b) PILOTS' EMERGENCY HATCH. *(Figure 507.)*

1. DESCRIPTION.—Directly above the pilot and copilot is a square escape hatch. To open, turn back two handles (figure 443) at the forward end and push up. The handles are held forward by a bungee between them. In flight the air stream will force the hatch from the two openings at the rear jamb.

2. REMOVAL. — To remove, turn back two handles at the forward end and push up. Two prongs at the rear of the hatch will spring from the two openings in the jamb. Disconnect cable attaching jamb to a brace between the prongs and lift off hatch.

(c) EMERGENCY PANEL, CARGO DOOR. *(Figures 507 and 508.)*

1. DESCRIPTION.—The forward panel of the cargo door is the safest and most generally used emergency exit. To open, unlock the latches (4, figure 508) and trip the emergency release (7, figure 508) on the jamb of the forward cargo door. Then kick the bottom side of the panel and the air stream will carry it away. The latch pulls the pins from the hinges of the panel.

2. REMOVAL.

a. Remove wire in latch mechanism by punching it out.

b. Remove mechanism by unscrewing it from the jamb.

(d) EMERGENCY WINDOWS. *(Figure 507.)*

1. DESCRIPTION.—The fifth window aft on both sides of the main cargo compartment is elongated to the level of the seats to provide emergency exits. Each window is banded in orange-yellow to distinguish it as an exit. The latch handle, marked "AUXILIARY EXIT," contains an arrow pointing in the direction of turning for opening. To open, turn handle clockwise and push out and up on window which swings from a wire through hinges at the top.

CAUTION

The windows are to be used ONLY when circumstances will not permit use of the emergency panel. The window MUST BE held open. When pushed, it does not fall from the fuselage as does the emergency panel. It is too narrow for an easy exit.

2. REMOVAL.—Open in normal manner and punch out wire from hinges.

(e) SMALL CARGO DOOR. *(Figures 507 and 510.)*

1. DESCRIPTION.—The small cargo door is used as an emergency exit ONLY when the airplane is grounded and the engines are not running. On the left of the fuselage, directly aft of the bulkhead behind the pilot, this door is ordinarily used either for loading small parcels into the forward compartments or for entrance of crew members when the main cargo compartment is too heavily loaded or crowded to allow loading or entrance in the usual manner. The door must be tied back when loading because of interference with the radio equipment.

CAUTION

Always keep the small cargo door closed when the engines are running.

2. REMOVAL.—To remove door, remove pins from hinges.

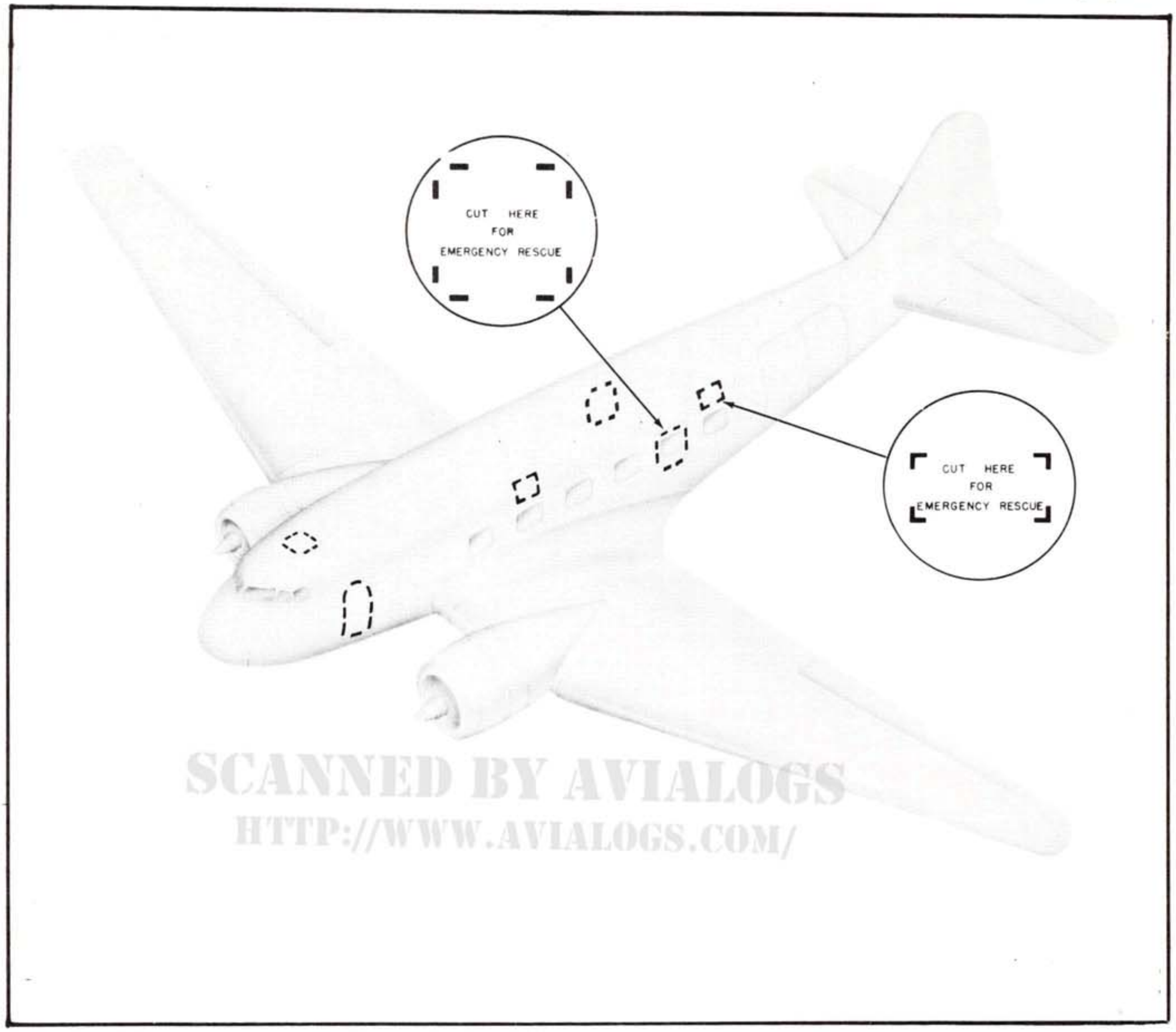


Figure 508A—Emergency Entrance Into Aircraft

(f) EMERGENCY ENTRANCE. *(See figure 508A.)*—Points of ingress are stenciled in orange-yellow on the outside of the aircraft for the purpose of showing the most vulnerable spots in which to chop an entrance into the aircraft for an emergency rescue of the crew. Besides the two emergency exits in the rear compartment, the pilots' escape hatch and the forward cargo door, there are also two points of ingress on the left hand side of the airplane, one between stations 234½ and 258½ and one between stations 390½ and 411½.

CAUTION

These points of ingress are to be used only when other means of entry into the aircraft cannot be used.

(2) FOLDING LADDER. *(Figures 509 and 510.)*—A folding ladder is stowed on the bulkhead forward of the small cargo door. It is supported by two bungee

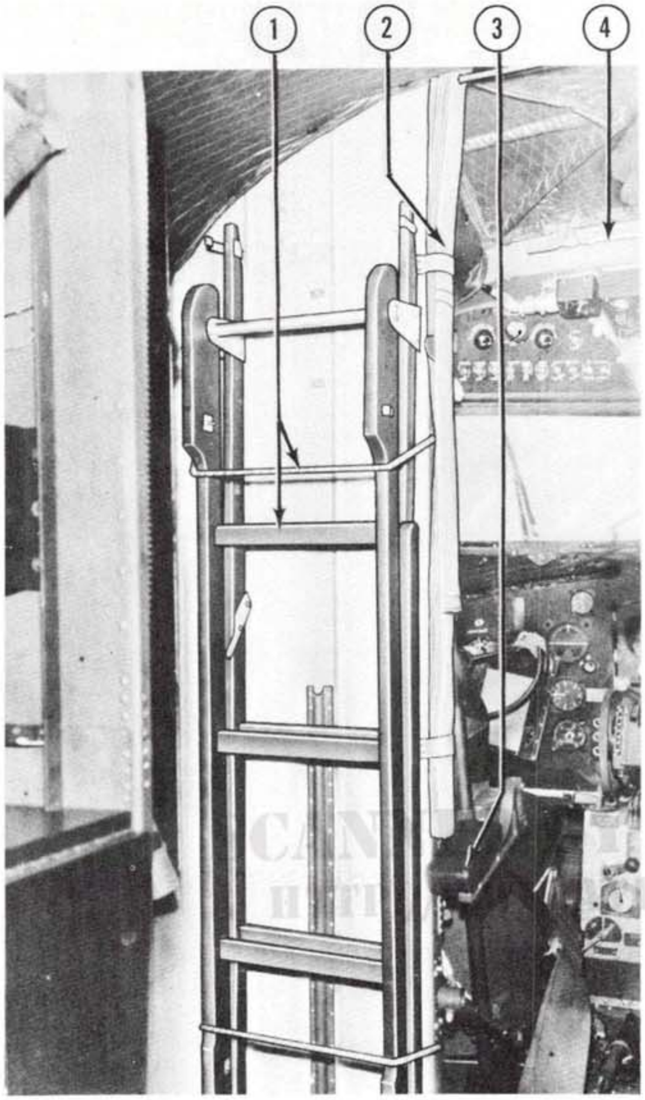


Figure 509—Folding Ladder (Stowed)

1. Ladder and Bungee
2. Blackout Curtain (Pilots')
3. Arm Rest (Pilots' Seat)
4. Bungee (Pilots' Escape Hatch)

cords (1, figure 509) which pass through eyebolts. It is made of plywood and folded into three sections. When fully extended it provides a ladder for emergency exit, entrance, or loading at small cargo door. The door must be tied back because of interference with the radio equipment. Don't use this for an all-purpose utility ladder. It is too light in construction and may buckle.

(3) HAND FIRE EXTINGUISHERS.

(a) DESCRIPTION. *(See 2, figure 508 and figure 494.)*—Two portable C-21P manually operated fire extinguishers are provided to combat fires in the fuselage. One is installed in the pilots' compartment on the aft bulkhead above the pilot's head, and the other is installed on the rear section of the main cargo compartment door. On late C-47B airplanes, an additional A-17 CO_2 extinguisher or an A-20 CB extinguisher is added in the radio compartment just above the main junction

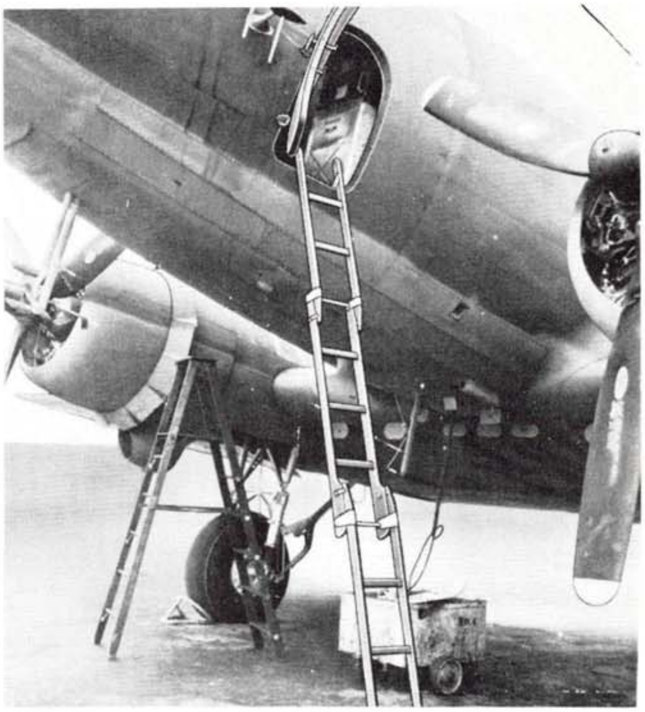


Figure 510—Folding Ladder (Installed)

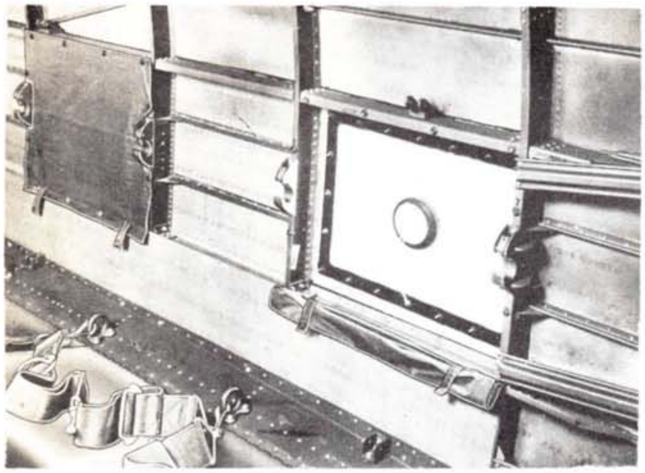
box on the left-hand side of the airplane. The C-21P extinguishers are supported in aero-type brackets which hold them firmly in place but permit quick removal. Each fire extinguisher has 1 quart liquid capacity, and is filled with a fluid mixture consisting of 70 percent fire extinguishing liquid, Federal Specification No. O-T-631, by volume. Effective range is 25 to 30 feet and the extinguishers can be used to quench any type of fire since the liquid is a nonconductor of electricity. The effectiveness of the extinguishers is not diminished by low temperature. The extinguishers weigh about 7 pounds each when fully charged. The pump handles are panic-proof type opening with a short turn to the left.

The A-17 fire extinguisher has a capacity of 7 lbs. 4 oz. of carbon dioxide in compressed liquid form. The effective range is approximately 7 to 10 feet and can be used to quench any type flame. Take care to keep temperature of cylinder below 54.4 degrees Centigrade (130 degrees Fahrenheit) as excessive temperatures will cause a premature discharge.

CAUTION

> Stand as far away from the fire as possible. The fire extinguisher fluid (carbon tetrachloride) when sprayed on a fire, produces phosgene, a poisonous gas. Inhalation of a small quantity may be serious; inhalation on a large scale may prove fatal.

(b) MAINTENANCE REPAIR OR REPLACEMENT.—In event any leakage of fluid from a hand extinguisher is disclosed it will be considered mechanically defective and therefore unserviceable. Each serviceable extinguisher will be kept sealed and tagged with the last date of filling and inspection for pump action.



(c) MAINTENANCE OF TYPE A-20 HAND FIRE EXTINGUISHERS.—Type A-20 bromochloromethane (CB) fire extinguishers may be used on any type fire which may occur in aircraft. CB is much less toxic than carbon tetrachloride and slightly more toxic than carbon dioxide. Pressure in the extinguisher will be maintained at 150 to 175 psi by charging with "dry" air. Upon discharge of the agent in the extinguisher, service with bromochloromethane, stock No. 8500-237000, as follows:

1. Remove the valve assembly.

2. Fill the extinguisher with one quart of bromochloromethane.

3. Install the valve assembly.

4. Recharge with 150 to 175 psi of "dry" air.

5. Change date (month and year) on inspection tag, or replace tag.

CAUTION

Bromochloromethane is a moderately toxic chemical compound. From a chronic exposure point of view it is somewhat less toxic than carbon tetrachloride. However, from an acute point of view it is more toxic than carbon tetrachloride. Pyrolyzed vapors of bromochloromethane are considerably more toxic than the undecomposed vapors. Splashes on the skin and eyes will be quite irritating and should be removed with water as soon as possible. Despite the toxic nature of this chemical it can be handled with relative safety if personnel are aware of the hazards involved and comply with the following precautions.

Do not use more CB than necessary to extinguish the fire.

Avoid unnecessary exposure to both liquid and vapor CB during fire fighting operations.

Avoid exposure to decomposed vapors.

Personnel engaged in recharging CB containers and who are routinely exposed to varying concentrations of the chemical should be given periodic medical examinations.

(4) FIRST-AID KITS.—Thirteen first-aid kits will be carried in the following positions: on both sides of the bulkhead behind the pilot; aft side of the bulkhead behind the navigator; at the right and forward side of the bulkhead in front of the lavatory; five along the right side of the cabin above the seats; and four along the left side above the seats.

Note

Seals on the first-aid kits must NOT be broken until their equipment is needed.

(5) BLACKOUT CURTAINS.

(a) SIDE WINDOW CURTAINS. *(Figure 511.)*

1. DESCRIPTION.—Vina chloride (airplane cloth weatherproofed with chloride) curtains are rolled and hung to the window sills by screws. When unrolled, the curtains will attach to durable dot fasteners at the tops of the windows. The curtains are designed to prevent light inside the cabin from shining through the windows.

2. REMOVAL.—To remove curtains, unloosen them from the screws.

(b) PILOT COMPARTMENT CURTAINS. *(2, figure 509 and figure 494.)*

1. DESCRIPTION.—On some airplanes Vina chloride curtains are attached by screws to the left side of the companionway entrance in the middle of the bulkhead aft of pilot and copilot. The curtain, suspended from a plywood rod across the companionway will, if extended, button to the other side and prevent light from shining through to the pilot's compartment. Each curtain is held to the bulkhead jamb by straps, which also mount the snaps fitting over the studs at the right jamb.

2. REMOVAL.

a. Remove rod attaching clip at right jamb and disconnect rod.

b. Remove screws holding curtain to jamb.

c. Slip curtain off rod.

(c) ASTRODOME CURTAINS.

1. DESCRIPTION.—A black poplin curtain is held by two straps screwed to the ceiling to the left of the astrodome. It may be extended to attach to durable Dzus fasteners on the right of the dome. The curtain keeps light from shining through the dome.

2. REMOVAL.

a. Remove curtain by unloosening straps.

b. Remove straps by detaching holding screws.

(d) NAVIGATOR AND RADIO OPERATOR WINDOW CURTAINS.

1. DESCRIPTION.—Curtains similar to the astrodome curtains are provided for the small windows to the left of the navigator and above the radio operator.

2. REMOVAL.

a. Unloosen straps.

b. Remove straps by detaching holding screws.

(6) SAFETY BELTS. *(Figure 511.)*

(a) DESCRIPTION.—There are 27 safety belts for the 27 seats in the cabin compartment. They are constructed of heavy, washable, cotton fabric. Metal handclasps at either end connect the belts to the safety belt rings. The belt may be disconnected at the middle by a metal handclasp protected by a leather pad. Between each end and the middle is a metal web for adjusting the length of the belt.

(b) REMOVAL.

1. To remove a belt from two safety belt rings, unfasten the handclasps at both ends of the belt.

2. To remove or separate halves of a belt, unfasten the handclasp in the middle.

(7) SAFETY BELT RINGS. *(Figure 511.)*

(a) DESCRIPTION.—Back of each seat, two safety belt rings are bolted to a long, seat-support beam bolted to the fuselage frames. The oblong base is an integral part of each ring. A short, heavy bolt penetrates each corner of the base, the beam, and a 2-inch,

reinforcing nut plate beneath the beam. Used for tie-down as well as safety belt rings, they are designed for 500-pound loads exerted within 45 degrees from the top of the rings.

(b) REMOVAL.—Remove ring by unscrewing the four, 10 by 33 bolts securing the ring to the beam.

(8) LIFE RAFTS.

(a) DESCRIPTION.—Three type A-3 life rafts shall be installed at jump-off points before long, over-water flights. Provision is made for stowage on the right side of the main cargo compartment. The five-man raft is constructed of rubberized fabric. When inflated with CO_2, the supporting tube (110 by 60 inches) gives the raft a boat-like appearance. A horizontal bulkhead divides the tube, providing upper and lower compartments, each inflatable through a mattress valve. The raft shall be capable of supporting 1,000 pounds. The weight, exclusive of accessories and inflation gear shall not exceed 36 pounds. The diameter of the supporting tube inflated shall be approximately 15 inches. Life rafts shall not be continued in service longer than 3½ years. Each raft is provided with: two inflatable seats, an oarlock, mast holder, two accessories pockets, three oars, life line, two righting ropes, emergency signal kit, CO_2 cylinder, inflation system, valve hood cover, cylinder valve, pull cord and grip, manifold, check valve, hand pump and hose, bailing bucket, repair kit, 40 feet cotton cord (75 pound test), central accessories container, sea anchor, pyrotechnic pistol and five distress signals, seven cans of emergency drinking water, three seamarker dyes, nine packages type "K" rations (five dinners, four breakfasts), one flashlight, floating type, and battery, scout knife, police whistle, first-aid kit, emergency fishing kit, paulin for use as a sail, paulin for catching water, signal, shade and camouflage, four bullet hole plugs (wood), and combination compass and match container.

(b) MAINTENANCE.

1. INFLATION AND DEFLATION. – Following are instructions for inflation and deflation of life rafts.

a. TO INFLATE.—Pull valve release cord with a jerk. The raft shall inflate to a well-rounded condition in not more than 40 seconds at 21°C (70°F). Inflate seats with the hand pump.

b. TO DEFLATE.—Remove mattress valve plugs. Exhaust gas with a deflation pump. Install a charged CO_2 cylinder. Roll up raft from one end toward the valves. Replace valve plugs.

c. TO PUMP UP.—Attach pump hose to mattress valve; open valve plug two turns, then pump; close valve plug tight, then remove pump hose.

CAUTION

Keep everything tied to raft to avoid loss in case of capsizing.

2. PACKING.

a. The raft shall be folded and packed so that the valve shall be readily accessible upon removal of the raft from the carrying case. Cover the surface of the raft thoroughly with talc before repacking it.

b. When not in use in aircraft, the raft shall be unfolded and stored away from the light in a cool, dry location. If storage facilities are limited, rafts shall be stored in the carrying cases and the cases in cardboard cartons.

3. REPAIRS.—No repairs will be made to rubberized fabric or latex bladders other than patching of small holes. Such repairs will be made by cold patching, using three coats of rubber cement. Large tears, rips and severely chafed areas will be cause for condemnation. Normally, maintenance repairs and inspection requiring inflation tests will be performed by the station parachute repair personnel.

4. CO_2 CYLINDERS.—3.25 pounds of CO_2 gas shall be maintained in the inflation cylinder. (Cylinder marked: "For Use With Type A-3 Raft").

d. MISCELLANEOUS EQUIPMENT.

(1) CABIN ENTRANCE STEP. *(1, figure 508 and 10, figure 512.)*—A dural, cabin entrance step is stowed on the left side of the bulkhead in front of the lavatory. It is held by bungees at top and bottom which pass through four eyebolts on the bulkhead. To use, suspend it by attaching the two hooks in the top of the step to fittings (holes) about 11 inches apart in the sill at the forward end of the cargo door. There are three steps; the lower two built in the assembly, and the upper one consisting of the sill. A sponge pad braces the step against the contour of the fuselage.

(2) STARTER HAND CRANK AND GEAR BOX. *(9, figure 512.)*—The starter hand crank and gear box (an integral unit) is used for emergency starting of the engines. It is installed through a hole above the starter access door at the aft, lower end of the accessory cowling, and is stowed above and to the right of the cabin entrance step, stowage position.

(3) CARGO DOOR HANDLE GUARD. *(3, figure 508.)*—To eliminate the possibility of the paratroopers' equipment becoming fouled on the door handles when leaving the airplane, a detachable canvas guard may be fitted over the handles of the forward, main cargo door. The parachute door must be removed. The button fasteners of the guard fit over studs aft of the door handles. The guard is stowed by means of straps on the inside and forward side of the aft cargo door.

(4) ENGINE COVERS. *(8, figure 512.)*—Two canvas engine covers are stowed on the right, bottom side of the bulkhead in front of the lavatory compartment. The covers extend over the fire wall, over the entire cowling, and are tied at the front end over the propeller hub. A zipper, running lengthwise under the center

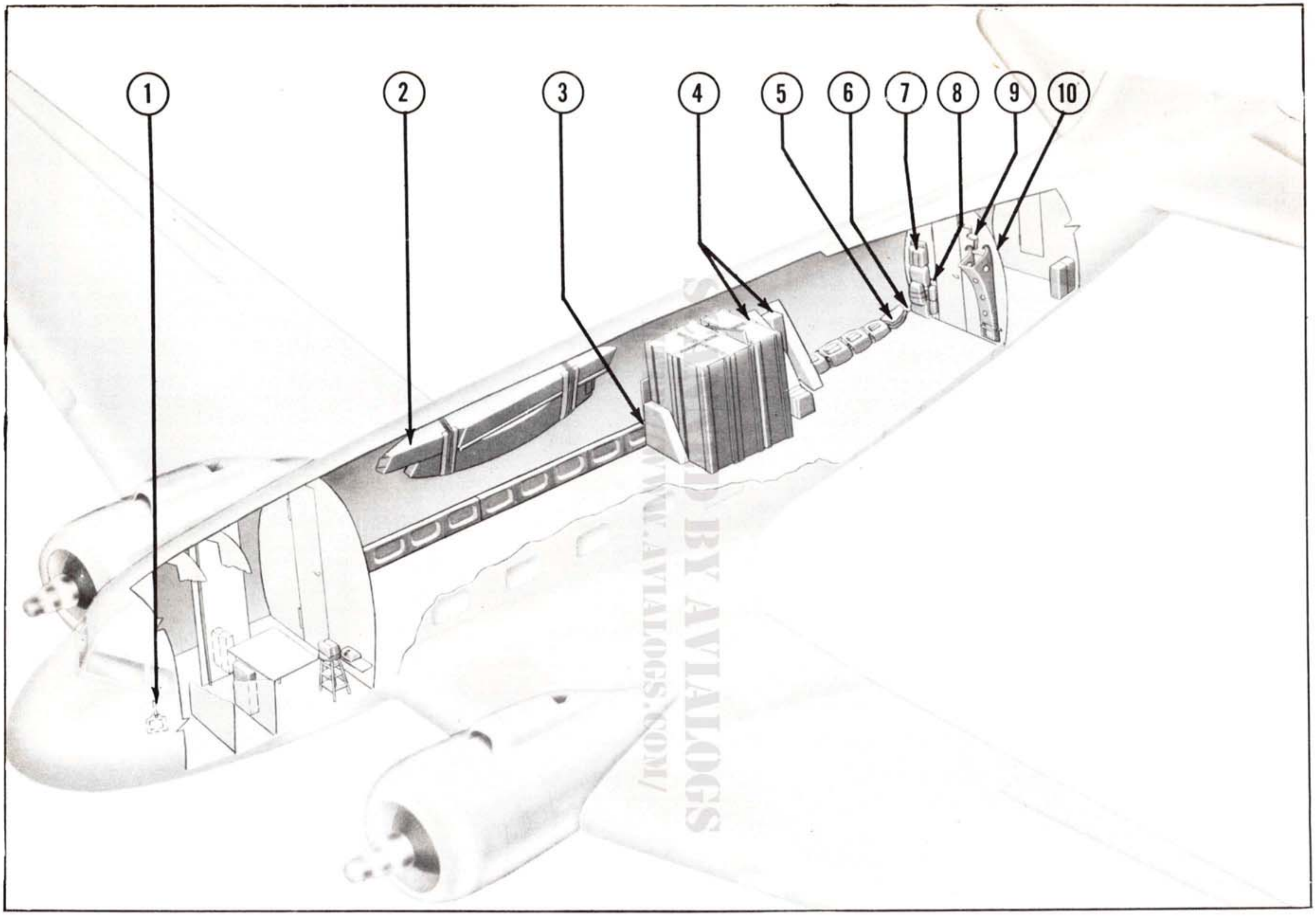


Figure 512—Stowage of Loose Items

1. Pilot's Check List Holder
2. Loading Ramp
3. Loading Ramp
4. Loading Ramp
5. Exhaust Flame Dampeners
6. Plug Assembly
7. Canvas Container
8. Engine Covers
9. Starter Hand Crank
10. Cabin Entrance Step

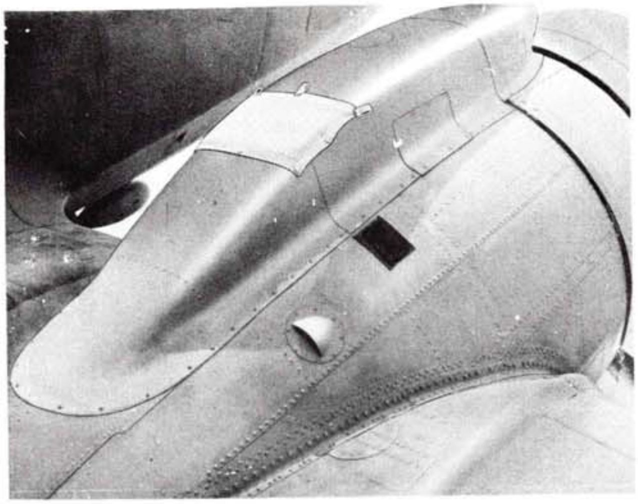


Figure 513—Nonram Air Filter Dust Excluder (Installed)

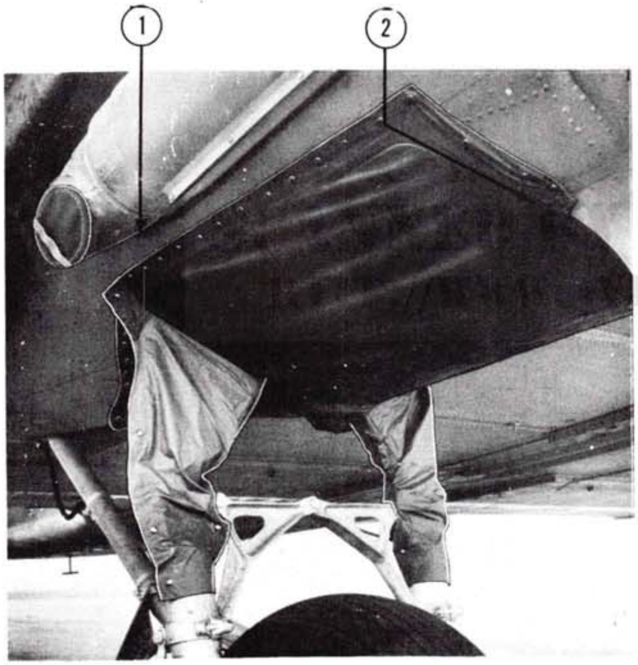


Figure 514—Nacelle Dust Excluder and Exhaust Plug Assembly (Installed)

1. Nacelle Dust Excluder
2. Exhaust Plug (Dust Excluder)

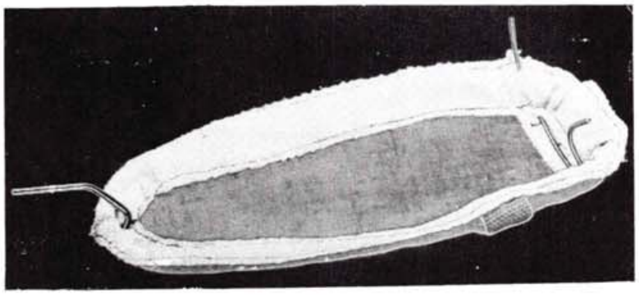


Figure 515—Exhaust Plug Assembly

of the cowling, opens and closes the cover. Two openings, one aft of the propeller hub and one at the starter access door, are provided for attachment to a ground heater. Openings at the bottom provide clearance for vent lines.

(5) CANVAS CONTAINER. *(7, figure 512.)*—Stowed above the engine covers on the right of the bulkhead in front of the lavatory compartment is a canvas bag containing the landing gear safety pins, the cargo tie-down fittings, the tail mooring anchor plate, the floor plug buttons, and the jack points and bolts when these are not in use.

(6) DUST EXCLUDER ASSEMBLIES.

(a) AILERON.—Small cloths trimmed with felt are fitted over the actuating arms of the ailerons to prevent dust from fouling the mechanism. They are stowed with the engine covers.

(b) SHOCK STRUT. *(Figure 127.)*—Rubberized and corrugated coverings are fitted over the shock strut pistons to protect them and the packing from dust.

Note

On some airplanes, wiper rings are used.

(c) NONRAM AIR FILTER. *(Figure 513.)*—A square, canvas covering may be clasped over the opening above and aft of the carburetor air filter to keep dust out.

Note

The foregoing assemblies are used on some airplanes.

(d) NACELLE. *(Figure 513.)* — Large canvas coverings, with slits to fit around the landing-gear assembly, may be slipped under the nacelles to keep out dust. There are studs about the lower rim of the nacelle opening to which the fastener buttons of the cover snap. The covering contains "pants" to protect the landing gear, upper truss and shock struts.

(e) COWL FLAP CYLINDER. *(3, figure 416.)*—A diminutive, rubberized and corrugated covering is fitted over the cowl flap cylinder and piston on the lower inboard segment of the antidrag ring, to keep the dust from fouling the actuating mechanism.

(7) EXHAUST FLAME DAMPENER. *(Figure 225.)*—Stowed in front of the engine covers are two metal, exhaust flame dampeners. They are attached to the ends of the exhaust stacks whenever it is desirable to obliterate flames coming from the exhaust stacks.

CAUTION

Great damage has been caused by the misuse of flame dampeners.

(8) PLUG ASSEMBLY, MUFF TYPE. *(2, figure 514 and figure 515.)*—Stowed with the engine covers are two oval pads trimmed with asbestos. These are used to plug the exhaust stack and keep out dust.

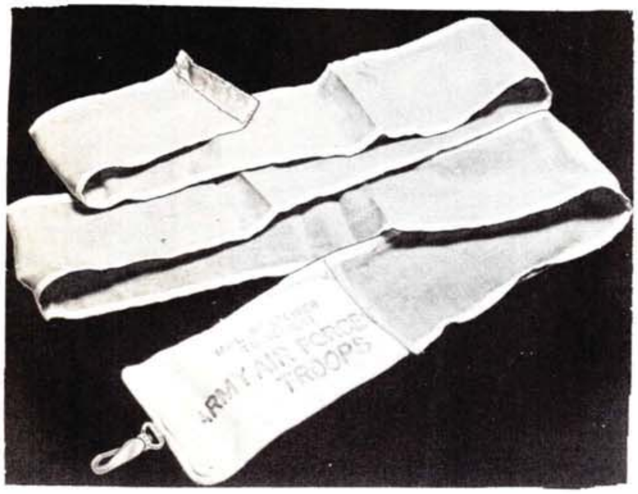


Figure 516—Drop Message Bag

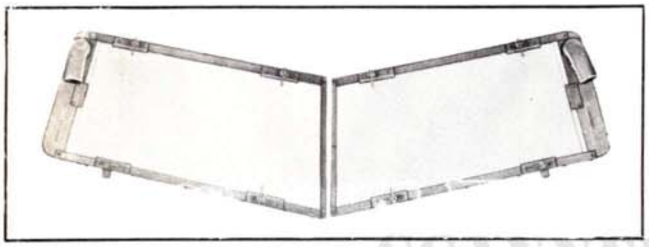


Figure 517—Windshield Defrosters

(9) NAME PLATES.

(a) GENERAL.—There are four name plates: the Douglas Aircraft name plate; the Army name plate; the radio call name plate; and the radio compass name plate.

(b) DOUGLAS AIRCRAFT CO. NAME PLATE.—At the top of the hydraulic control panel between the copilot's and baggage compartments is the plate containing the factory and model numbers of the airplane, and the date of manufacture.

(c) ARMY NAME PLATE.—To the right of the Douglas Aircraft Co. name plate is the smaller, Army plate containing the serial and order numbers, and the date of acceptance of the airplane by the Army from the company.

(d) RADIO CALL NAME PLATE.—In front of the pilot on the instrument panel is a very small, black plate containing the radio call number in white.

(e) RADIO COMPASS NAME PLATE. — A black, radio compass operational plate is directly behind the copilot.

(10) DATA HOLDERS.

(a) MAP AND DATA HOLDERS.—Identical in construction, two plywood map and data cases are installed on the fuselage sides, one to the left of the pilot, and one to the right of the copilot. Prescribed technical instructions and handbooks applicable to the airplane are carried in these cases.

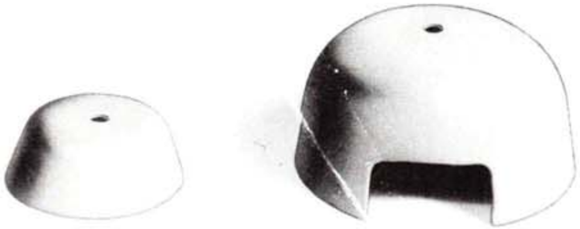


Figure 518—Tail Wheel Guards

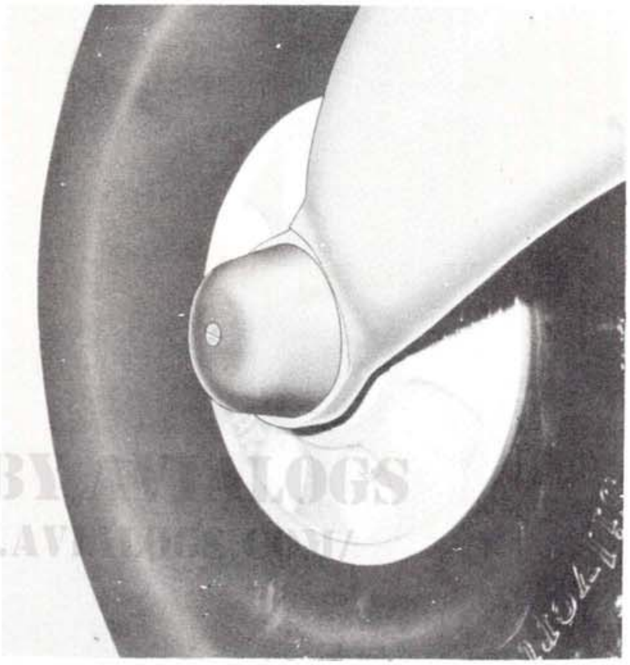


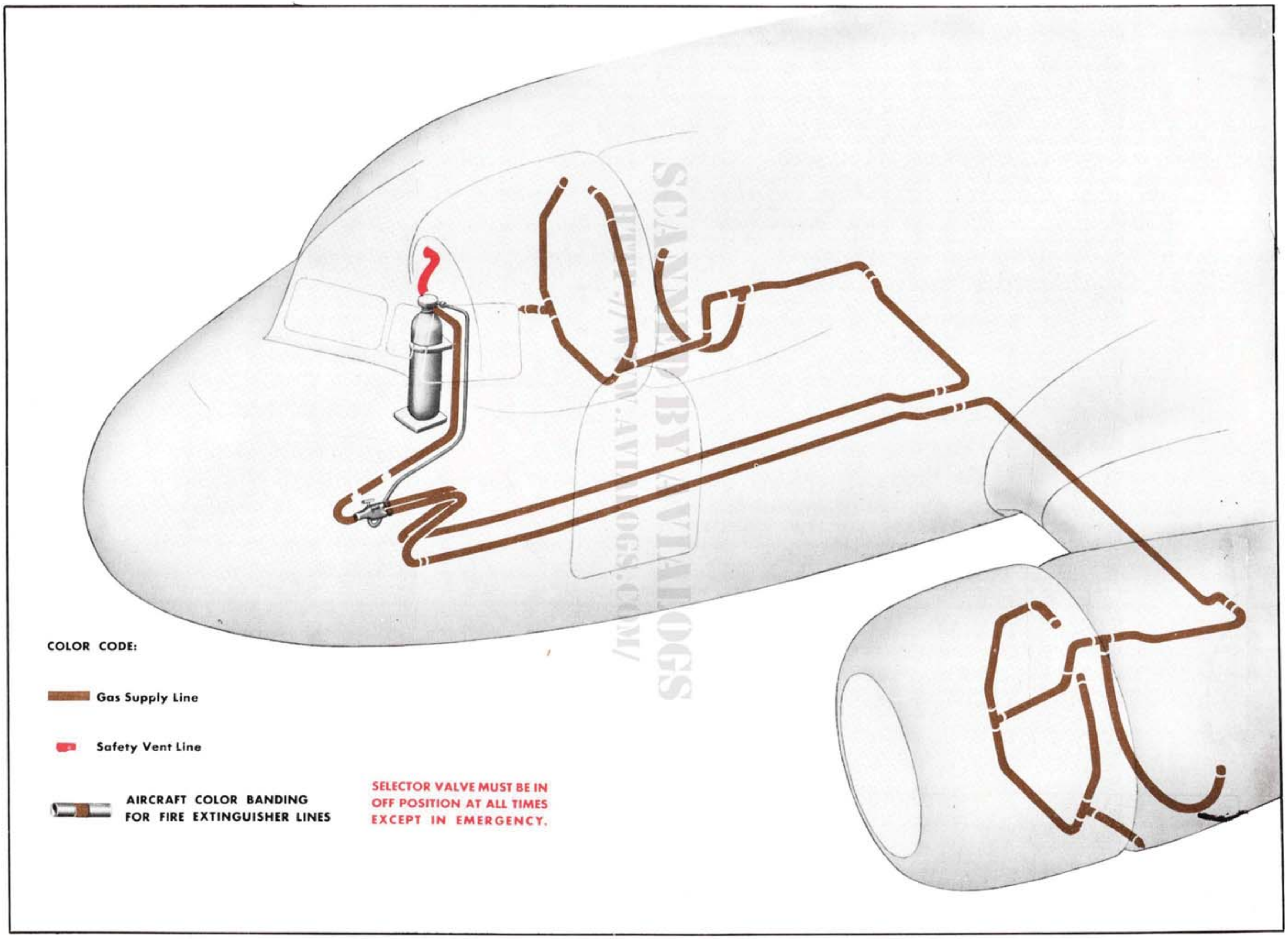
Figure 519—Tail Wheel Guard (Installed), Right-Hand Side

(b) COMPASS CORRECTION CARD HOLDER.—Forward of the pilot on the instrument panel is a Plexiglas holder containing a card to indicate compass corrections. A similar holder and card are at the side of the navigator's compartment.

(c) PILOT'S CHECK LIST HOLDER. *(1, figure 512.)*—To the left of the correction card holder is an identical holder. It contains the pilot's check list for these airplanes.

(11) INFORMATION CHARTS.—A fuel system chart is installed on the left face of the left wall of the baggage compartment. A smaller fuel system chart is directly behind the pilot below the fire extinguisher. Oxygen and heating system charts are installed on the front of the door separating the cabin and radio compartments. Wiring charts are on the main junction box aft of the small cargo door and on those in the front of the nacelles.

(12) TOOL KITS.—The engine, propeller, hydraulic, de-icer patching, and emergency repair kits will be carried in the baggage compartment.


COLOR CODE:
Gas Supply Line
Safety Vent Line
AIRCRAFT COLOR BANDING FOR FIRE EXTINGUISHER LINES

SELECTOR VALVE MUST BE IN OFF POSITION AT ALL TIMES EXCEPT IN EMERGENCY.

Figure 520—Engine Fire Extinguisher System

Note

A radio repair kit and crew chief emergency kit have been added.

(13) PROTECTIVE FLOORING.—Plywood floor panels are 3/16 inch thick and coated with a durable sandy composition. They are used to prevent the cabin floor from becoming dented and scratched.

(14) DROP MESSAGE BAG.—A white weighted bag with a long, yellow streamer may be used by crew members for dropping messages. (See figure 516.)

(15) WINDSHIELD DEFROSTERS. *(Figures 517 and 526.)*—A left- and right-hand inner pane may be attached directly behind the two front windshield panes (one on either side of the "V") to leave a space between the regular windshield pane and the inner pane. On either inner pane is an outlet for connection to a tube of the heating system. If connected, by turning a valve, hot air will enter the space between the inner and windshield pane and defrost both panes. When not in use, the defrosters are stowed under the navigator's table. (See paragraphs 14.*1*.(6) and 18.*b*.(11), of this section.)

(16) SURFACE CONTROL LOCKS.—There are five surface control locks: one for each aileron, one for each elevator, and one for rudder. Used only when surfaces are in "NEUTRAL" position, locks are applied to keep surfaces STEADY in the "NEUTRAL" position. The locks are plywood with felt padding. When not in use, locks are stowed in a canvas bag on floor of lavatory.

(17) TAIL WHEEL GUARDS. *(Figures 518 and 519.)*—Cup-like metal guards may be fitted over the tail wheel towing lugs to prevent parachutes and similar equipment from fouling on the lugs. A screw fits through center of guard into threads in middle end of each lug.

(18) BLIND FLYING HOOD.—A black rayon hood is provided to cover pilot completely and prevent visibility when flying by instrument. Attached to left side of the pilots' compartment, the hood extends across the left half of the instrument panel, between the pilot and copilot, to the bulkhead behind the pilot.

(19) CANVAS BAGS.—On some airplanes six canvas bags are carried for ballast.

(20) SMOKE GRENADES.—On late C-47B airplanes four smoke grenades (two red and two white) are stowed in a canvas bag on the left side of the navigator's compartment.

(21) FOOT STOOL.—On late C-47B airplanes a foot stool, for use in connection with the navigator's astrodome, is stowed on the right-hand side of the baggage compartment.

(22) CIRCUIT WIRING DIAGRAM BOOK.—On late C-47B airplanes a system wiring diagram book is stowed in the Data Case on the bulkhead at station 177½.

17. ENGINE FIRE EXTINGUISHER SYSTEM.

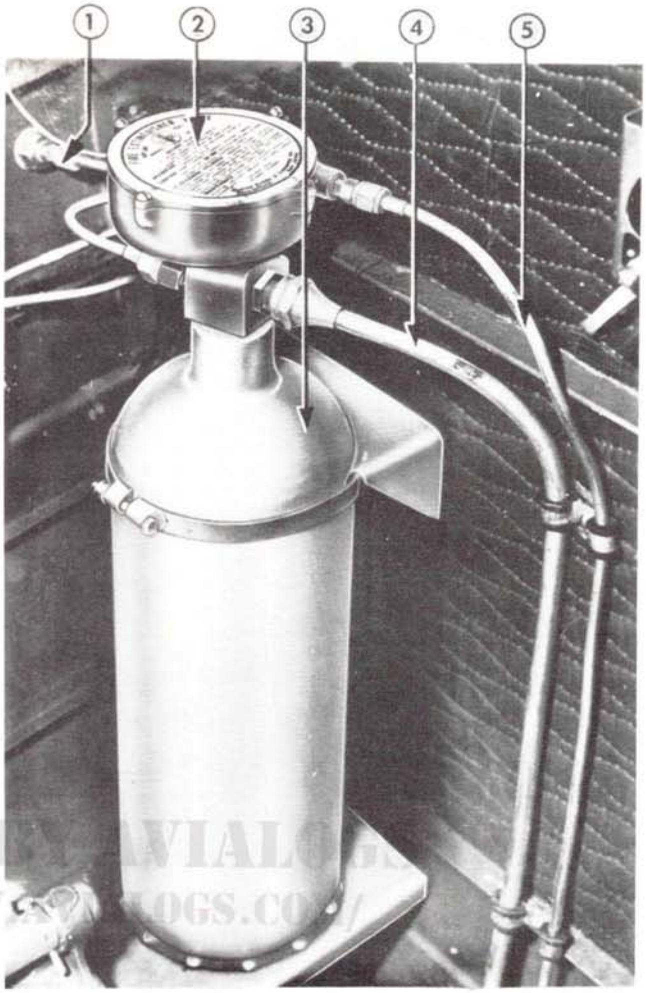


Figure 521—CO_2 Cylinder Installed

1. Outlet Fitting
2. Fire Extinguisher Operating Valve
3. Cylinder Assembly
4. Main Distribution Line
5. Cable Conduit

a. GENERAL.—This airplane is equipped to fight engine fires instantaneously while in flight or on the ground. A fire in either engine can be extinguished from the pilot's compartment by two simple operations. A fire in other parts of the aircraft can be combated with hand fire extinguishers provided in pilots' compartment and in fuselage (figure 521). Heart of the engine fire extinguishing system is a Lux CO_2 cylinder and remote control valve assembly (figure 522) which provide the flame-smothering carbon dioxide, the pressure required to distribute the liquefied gas to engines, and a means of remote control. The gas is distributed by lines from CO_2 cylinder valve to control panel assembly (figure 520), and then to the engines via the fuselage and wing tunnels (figure 520). The lines terminate in perforated loops which encircle the engines (figure 520). The ends connect to carburetor hot air adapter.

(1) OPERATION.—To operate the engine fire extinguisher system, set selector valve in control panel assembly for the engine which is on fire then pull upward on the adjacent control handle connected by cable to the release lever in the CO_2

cylinder valve. The compressed liquid in the CO_2 cylinder rushes in one burst to the outlets in the affected engine. Contact with the air converts the liquid into gas and "snow" which stifle the flames.

(2) PORTABLE APPARATUS.—The system can be used to extinguish warm-up engine fires without discharging the mounted CO_2 cylinder by connecting a portable CO_2 extinguisher to a ball check valve which protrudes from the engine compartment on the outboard side.

CAUTION

White discharge which forms at pressure points is dry ice and prolonged contact with skin will cause frostbite.

b. LUX CO_2 CYLINDER AND REMOTE CONTROL VALVE ASSEMBLY.

(1) DESCRIPTION. – The assembly, utilized to combat engine fires, consists of a lightweight machined steel cylinder with a remote control valve threaded into its neck. The cylinder has a capacity of 7 pounds, 4 ounces of carbon dioxide in compressed liquid form. Pressure in the cylinder depends on the temperature, with a pressure of 504 psi at 0°C (32°F) becoming 849 psi at 21.1°C (70°F). The assembly is installed vertically on the floor back of the copilot's seat and the cylinder is clamped to the wall by a bracket especially designed to withstand violent maneuvers and landing shock, and at the same time permit ready inspection, removal or replacement. The remote control valve threaded into the top of the cylinder contains a release mechanism and outlets for the release cable line, gas supply line, and safety vent line. The safety vent line extends to a dustproof opening in the fuselage skin. It serves as a means of exhaust for the CO_2 if there is a premature discharge from the cylinder. Such a discharge is revealed in the valve inspection window where a red target will appear, and in the outboard safety discharge fitting, where a red celluloid disc will be broken. The gas content of the cylinder and valve assembly when it is being inspected or recharged is always determined by the weight system. For inspection purposes the valve cover plate is removed and the assembly is weighed on a scale which is accurate to within 2 ounces. If it is found that the gas charge has decreased 4 ounces or more from the FULL weight stamped on the valve body (18 pounds, 6 ounces) the cylinder must be recharged or replaced. The premature discharge of a cylinder usually is caused by excessive temperatures. A safety disc is provided to release the gas at a pressure attained when a temperature of approximately 54.4°C (130°F) is reached. Care must be taken therefore to keep the temperature below 54.4°C (130°F). Charged cylinders never should be allowed to stand in the hot sun. CO_2 cylinders can be distinguished from other types of pressure bottles by the markings. These consist of an "S" stamped on the valve body and a black dot painted on the base.

Desert Note

Temperature of a cylinder can be reduced substantially by removing it from its mounting bracket, wrapping it with a dampened strip of 1-inch felt and then clamping it back into place. The felt should be moistened daily with a cup of water. Cylinders in transport or storage can be cooled in a similar fashion by covering them with a moistened blanket or pieces of felt. Cylinders treated in this way must be repainted more often than otherwise because the moisture encourages rust.

(2) REMOVAL AND DISASSEMBLY.

(a) Remove cover plate, take out cotter pin and disconnect control cable from long lever. Do not disturb operating levers.

(b) Disconnect the control cable tubing from the cable outlet.

(c) Disconnect gas line from gas outlet.

(d) Disconnect outboard safety vent line.

(e) Loosen band which grips cylinder and remove cylinder from bracket.

Note

When removing fitting from gas outlet, the preferable tool is a B-nut tube wrench. Do not force fitting. If it binds, use penetrating oil around threads and back of sleeve. After removal apply thread lubricant to fitting.

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) LUX CO_2 CYLINDER AND REMOTE CONTROL VALVE ASSEMBLY.—Do not attempt to repair cylinders or remove body bushings or valves threaded directly into cylinders. Replace cylinders requiring repairs. Repaint rusted cylinders with one coat of brushing lacquer, preferably bronze green.

(b) CHARGING OF CYLINDERS. – Equipment for the charging of all types of CO_2 cylinders has been supplied to the proper Army Air Forces activities. Except where recharging facilities are available at the station, cylinders which are empty or defective shall be replaced. The charging procedure, if proper equipment is available, is as follows:

1. Remove cover from valve.

2. Attach socket wrench No. 19256 (or ordinary wrench) to valve stem and turn counterclockwise until the levers snap into place and inspection window shows clear.

3. Charge through valve outlet, filling cylinder to rated capacity (see weight stamped on valve body). Close valve by turning stem clockwise, tightening securely.

4. Return cover to valve.

5. All necessary information should be entered on the instruction card which is inserted in the slot under the cover plate. Recharging instructions are given on this card.

WARNING

> Recharging of cylinders should not be undertaken by inexperienced personnel because of the personal danger involved if instructions are not followed carefully.

(c) DISTRIBUTION LINES.—Check distribution lines for deep scratches, dents, and deformities. If any of these conditions are found, replace affected lines. Remove slight scratches with a burnishing tool or crocus cloth and oil.

(4) TEST BEFORE INSTALLATION.—Test the distribution lines before the CO_2 cylinder and valve assembly is installed in the airplane to make certain the lines are free of dirt and dust. This can be accomplished without removing the lines or other equipment. Introduce compressed air from an outside source into gas line detached from cylinder and "blow out" any dirt which may be present through perforations in the engine lines, setting selector valve in control panel to first one and then the other engine. If a line is clogged, introduce a dry cleaning solvent, Federal Specification No. P-S-661A, and blow through line.

(5) ASSEMBLY AND INSTALLATION.

(a) Look at inspection window and make sure it shows clear (appearance of red cross indicates cylinder is empty).

(b) Weigh cylinder to make certain it contains full charge.

(c) Proceed in reverse of steps outlined in paragraph 5.*b*.(2), this section. The cylinder contains a rigid siphon and must be installed in a vertical position or at an angle no more than 30 degrees from vertical.

(6) FINAL TEST AFTER ASSEMBLY—TRIAL OPERATION.—A trial operation of the system can be accomplished by either of the two following methods:

(a) METHOD A.

1. Set selector valve on control assembly to either right or left engine.

2. Hook a spring balance over control handle and pull slowly until system is operated. Observe force required to operate system; this should not exceed 50 pounds.

3. Upon operation of system, gas should discharge around selected engine and into the area back of the fire wall. The gas will not wet or harm the engine.

4. Reset selector valve to "OFF" position.

5. Disconnect and remove empty cylinder.

6. Install charged cylinder.

(b) METHOD B.

1. Set selector valve to either engine.

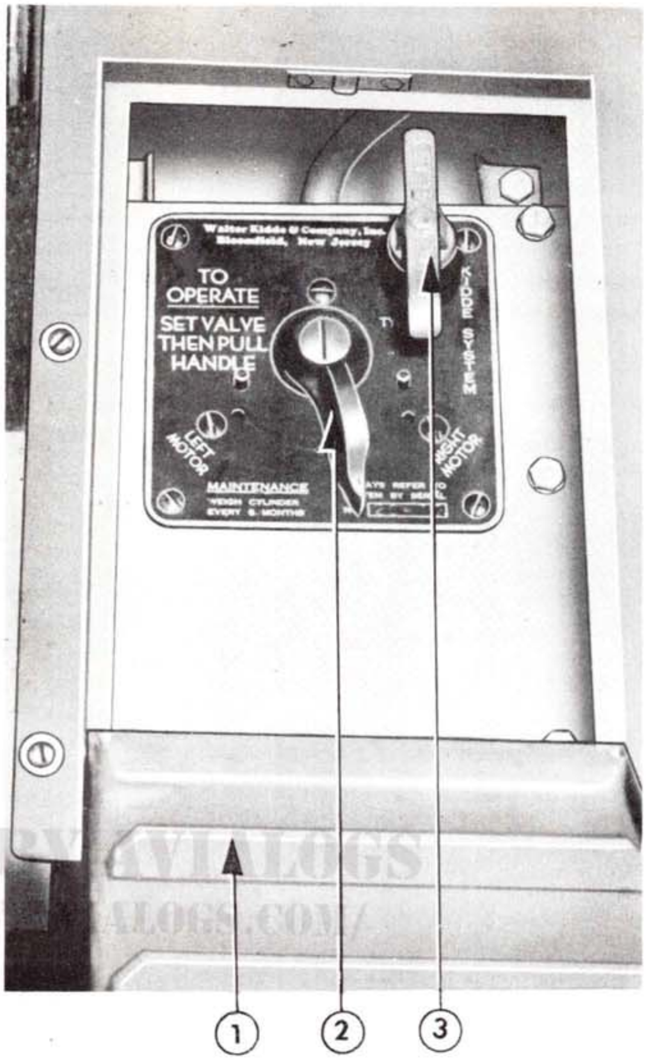

Walter Kidde & Company, Inc.
Bloomfield, New Jersey
TO OPERATE
SET VALVE THEN PULL HANDLE
LEFT MOTOR
RIGHT MOTOR
KIDDE SYSTEM
MAINTENANCE
WEIGH CYLINDER EVERY 6 MONTHS
1
2
3

Figure 522—Engine Fire Extinguisher Operating Panel

1. Cover Plate
2. Selector Valve Handle
3. Fire Extinguisher Valve Release Handle

2. Disconnect gas line from gas outlet at cylinder.

3. Connect air compressor hose to gas line.

4. Inject compound air into system, noting results at perforated outlets on engine.

5. Reconnect gas line to valve on cylinder.

6. Reset selector valve to "OFF" position.

c. CONTROL PANEL ASSEMBLY.

(1) DESCRIPTION.—The assembly, which permits remote release and distribution of the CO_2, consists of a control panel, an engine selector valve (figure 522) which routes the carbon dioxide to either engine, the control handle for the manual operation of the system, and a protective hinged cover. The assembly is installed in the pilot's compartment, flush with the floor between the pilot and copilot seats.

(2) REMOVAL.

(a) Remove seven screws in plate surrounding panel door and lift off plate together with cover.

(b) Disconnect fittings from four lines entering and leaving valve.

(c) Remove control handle by disconnecting cable from release lever in CO_2 cylinder valve and pulling cable through line.

(d) Remove hex bolts on control panel and lift out assembly.

(3) ASSEMBLY AND INSTALLATION. – Reverse of procedure outlined in preceding paragraph.

Note

To install control handle and cable: Splice end of cable to 6-foot length of iron wire; thread wire and attached cable through line from control panel to cylinder valve; connect cable to long lever.

CAUTION

Make certain that selector valve is set at "OFF" position.

18. HEATING AND VENTILATING SYSTEMS.

a. GENERAL.–A steam-type heating and ventilating system (figure 523) is installed in C-47 airplanes and in a limited number of C-47A airplanes–a hot-air type system (figures 527, 543 and 548) is installed in other C-47A airplanes. The steam-type system incorporates a boiler (figure 525 and 9, figure 523) in the right-hand engine exhaust tail pipe, in which water is converted to steam by the heat of the engine exhaust gases. This steam is passed into a radiator (1, figure 523) where it heats air brought in, through a scoop, from the outside. The heated air is then circulated through ducts to the compartments in the airplane. The hot-air type heating and ventilating system is installed in two different ways in C-47A airplanes (figures 527, 543 and 548). Both types, however, operate in essentially the same manner. Air from without the airplane enters a muff-type heat exchanger (figures 527, 528 and 543) which is an integral part of the exhaust tail pipe. The heated air then is routed to mixing chambers (figure 532), one for each heat exchanger, where it may be mixed with outside air. Refer to paragraph 18.*c.*(3), this section, for a description of the mixing chambers. After leaving the mixing chamber the air flows to the duct outlets located throughout the airplane (figures 527, 543, and 548). Ventilation in both the steam and the hot-air type heating and ventilating systems is accomplished by allowing only unheated air to go through the ducting system. Likewise, in both the steam and hot air systems, separate controls perform different functions. Some controls, in conjunction with the necessary linkages, ducts, valves and mixing chambers, regulate the temperature of the incoming air by allowing heated air, and air entering through scoops (figure 533) from the outside, to mix in the proper proportion. The other controls, located at duct inlets or duct outlet terminations, regulate the flow of air. An additional control on the steam-type heating and ventilating system is linked to a shut-off valve (5, figure 523) in the steam line between the boiler to the radiator.

b. STEAM TYPE HEATING AND VENTILATING SYSTEM. *(See figure 523.)*

(1) GENERAL.–The steam-type system consists of a boiler, a water supply tank and funnel (a reserve water supply tank is also installed on some airplanes), a pressure gage, a pressure regulator, a pressure relief valve, two air eliminators, two steam traps (on some airplanes one steam trap is eliminated), a shut-off valve, a radiator, two windshield defrosting shields, and necessary scoops, lines, ducts, outlets, controls, and control linkages. In operation, the water flows from the water supply tank (7, figure 523) to the boiler (9, figure 523) in the exhaust pipe. In the boiler, the water is converted into steam by the heat of the exhaust gases. The steam passes into the radiator (1, figure 523) through the steam supply line. In the radiator, the steam is condensed into water again by transmitting its heat to the air passing through the radiator to the cabin. The resulting condensate flows through a steam trap in the fuselage adjacent to the radiator and back to the boiler. An air eliminator (6, figure 523) on the water supply tank adjacent to the filler funnel, provides a vent through which the air in the system may be quickly eliminated during starting operations to prevent sluggish operation of the system. A second air eliminator (3, figure 523) is located in the condensate line from the radiator and is adjacent to the radiator. As the air eliminators are entirely automatic, they remain closed after the air has been expelled. The steam supply between the boiler and the radiator is tapped by a pressure balance line which is connected into the water supply tank and incorporates a steam pressure regulator (8, figure 523) that maintains 25 psi pressure in the water supply tank. The pressure drop created in the supply line by the steam condensing in the radiator allows the water to be forced into the boiler. A safety relief valve (10, figure 523) in the steam supply line prevents the steam pressure from exceeding 45 psi pressure should the steam pressure regulator fail to operate properly. A pressure gage is incorporated in the top of the water tank, or on some airplanes, adjacent to the radiator. The water in the steam system drains back into the boiler and the water supply tank.

CAUTION

When operating under freezing weather conditions, to prevent freezing of the steam heating system, use the following method whenever precautionary measures are indicated: IMMEDIATELY after stopping the engines, drain the water from the system. Make certain that the water in the reserve water tank (if installed) is drained with the system. When the system is free of water, stop the en-

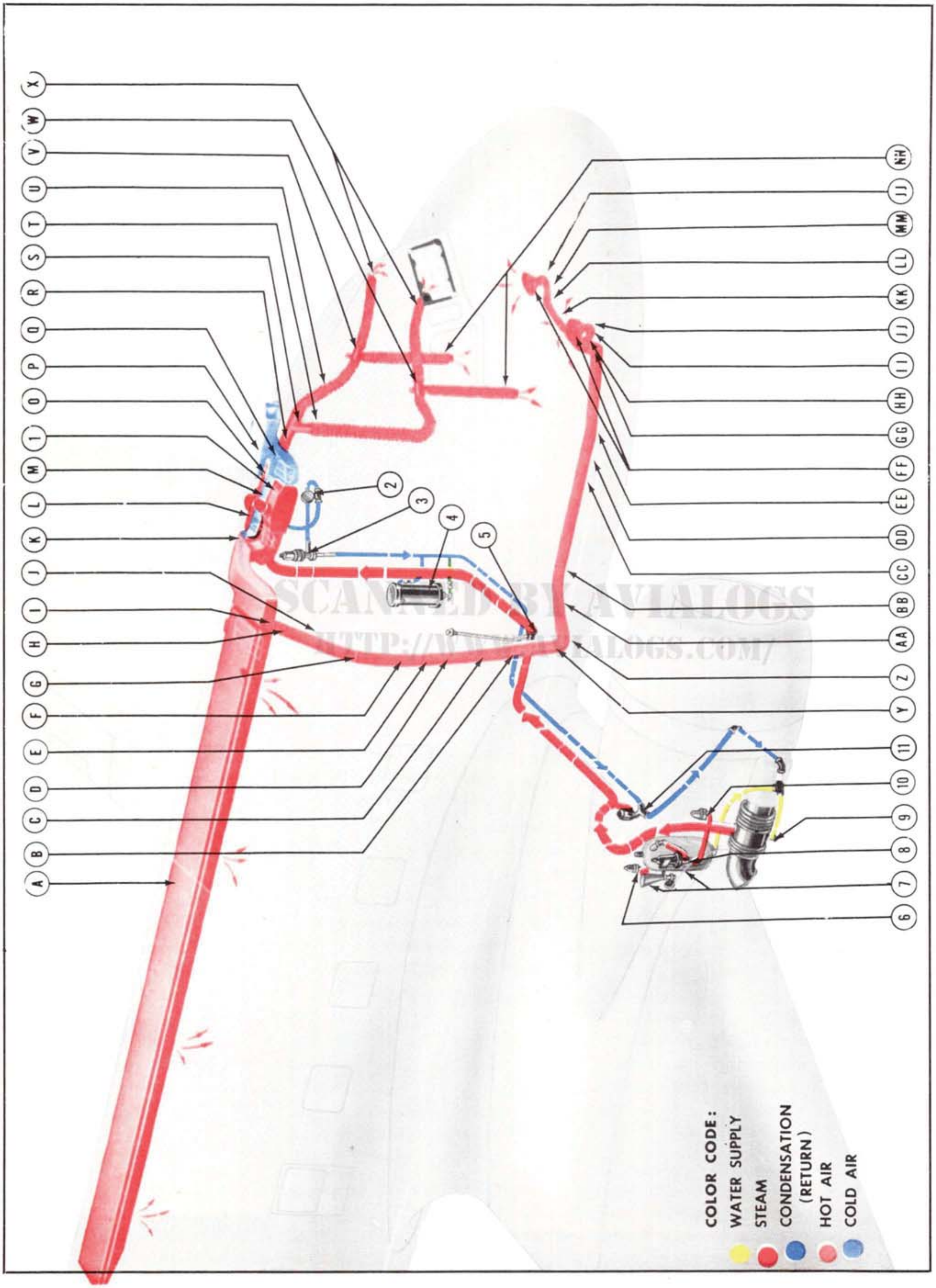

A
B
C
D
E
F
G
H
I
J
K
L
M
1
O
P
Q
R
S
T
U
V
W
X
2
3
4
5
NN
JJ
MM
LL
KK
JJ
II
HH
GG
FF
EE
DD
CC
BB
AA
Z
Y
11
10
9
8
7
6
COLOR CODE:
WATER SUPPLY
STEAM
CONDENSATION (RETURN)
HOT AIR
COLD AIR

Figure 523—Steam Heating and Ventilating System

KEY TO FIGURE 523

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1		Radiator	
2		Pressure Gage	
3		Air Eliminator	
4		Reserve Water Tank	
5		Steam Shut-off Valve	
6		Air Eliminator	
7		Water Tank and Tunnel	
8		Steam Pressure Regulator	
9		Steam Boiler	
10		Steam Relief Valve	
11		Steam Trap	

Note: Part numbers from 1 through 11 may be found in section VIII, figure 642.

A	5113167	Duct	1
B	4113876	Outlet (Radio Operator's)	1
C	2114420	Elbow	1
D	1108310-316-1900	Duct	1
E	2114147	Elbow	1
F	1108310-316-2800	Duct	1
G	2114403	Elbow	1
H	2115755	Valve (Pilot's Compartment Hot Air Control)	1
I	2114419	Elbow	1
J	1108310-316-2008	Duct	1
K	5116500	Duct and Mixing Chamber (on Some Airplanes This Unit Includes an Outlet for Attachment)	1
L	4142024	Elbow (If Installed)	1
M	3112618	Cold Air Duct	1
O	5113789-9	Scoop Drain	1
P	5115414	Duct Assembly	1
	5114755	Duct Assembly	1
Q	5113035	Duct Assembly	1
	AC882-8-11	Hose	1
R	2141690-2	Tube (If Installed)	1
S	4141534	"Y" (Branch) Assembly (If Installed)	1
T	2141690-8	Tube (If Installed)	1
U	2141690-6	Tube (If Installed)	1
V	4141433	Valve (If Installed)	1
W	4141433-1	Valve (If Installed)	1
X	2141690-2	Tube (If Installed)	2
Y	1108310-316-900	Duct	1
Z	2116322	Elbow	1
AA	1108310-316-1500	Duct	1
BB	2114293	Elbow	1
CC	1108310-316-4320	Duct	1
DD	2114757	Elbow	1
EE	1108310-316-3116	Duct	1
FF	4113957	Outlet Assembly	2
	2113956	Screen	2
GG	2114156	Elbow	1
HH	2114113	Tee Assembly	1
II	1108310-216-423	Duct	1
JJ	2114470	Elbow	2
KK	1108310-216-2000	Duct	1
LL	2114127	Elbow	1
MM	1108310-216-124	Duct	1
NN	2141689	Tube (If Installed)	2

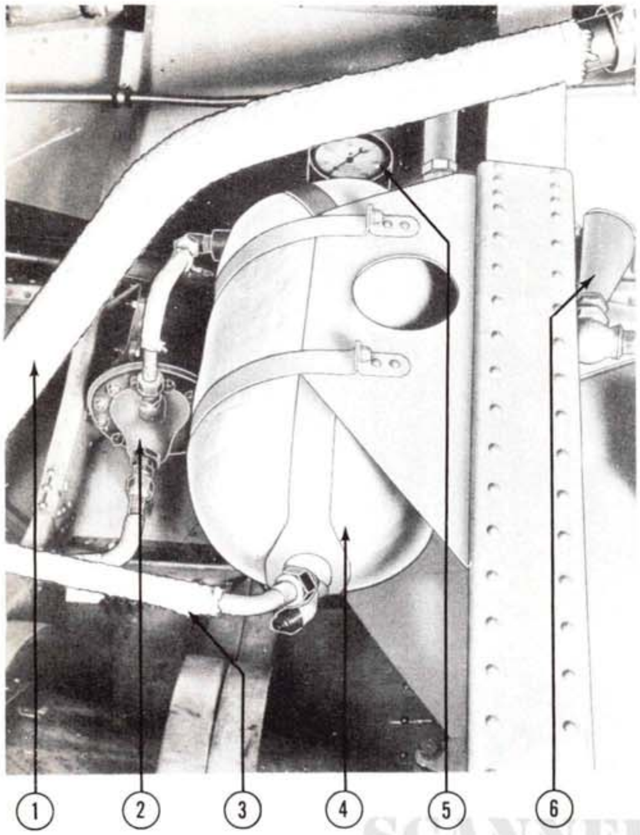


Figure 524—Main Water Tank Installed

1. Steam Line to Radiator
2. Pressure Relief Valve
3. Water Line to Boiler
4. Main Water Tank
5. Steam Pressure Gage
6. Water Funnel

Note: Refer also to figure 523.

gines. Close the drain valve and pour approximately 1 U.S. (.8 Imperial) quart of alcohol in through the filler opening. When the airplane is to be flown again, allow the engines to warm up. This permits the alcohol to vaporize. Then fill with water. The use of impure water will decrease the life of the system. If distilled water is not available, and it becomes necessary to use impure water, it is advisable to drain and blow air through drain lines every 50 hours. When operating under freezing conditions the steam system should be drained at all stops of over one-half hour.

Air enters the steam heating and ventilating type system through an air scoop (M, figure 523) at the top of the fuselage. The air scoop is constructed so as to divert the incoming air into two passages, one to the radiator (1, figure 523), and one around the radiator. Both passages merge into one duct aft of the radiator. This duct connects directly with the main cargo duct (K, figure 523) which runs the length of the cargo compartment (along the ceiling) from the forward bulkhead of the compartment to a point slightly forward of the main cargo loading door. On some airplanes a duct, immediately aft of the mixing valve, adjoins the duct which connects to the main cargo compartment duct. This duct, with the necessary additional hose attachments, terminates at the windshield defroster outlets and the pilots' hand warmer outlets. Another duct connects also with the duct immediately aft of the mixing valve. This duct and its various branches has outlet terminations at the radio operator's heat outlet (B, figure 523), and at the pilots' foot warmer outlets (FF, figure 523). The air temperature in the ducts is governed by the mixing valve control handle protruding from the duct just aft of the radiator. This handle is on a shaft that extends through both the hot and cold air passages and mounts a butterfly valve in each duct. The valves are so arranged that when one is completely open, the other is closed. Turning the handle in a clockwise direction increases the temperature. An intake (weather) valve contained in a duct immediately aft of the air intake scoop controls the flow of air into the radiator and the cold air duct (figure 539). The steam supply to the radiator may be shut off by a handle (5, figure 523) located on the floor against the aft bulkhead of the radio operator's compartment. Pulling up on the handle shuts off the steam. Hand controls, of the butterfly type, are located adjacent to the various outlets.

(2) WATER SUPPLY TANK ASSEMBLIES.
(See 4 and 7, figure 523.)

(a) DESCRIPTION.—A 4 U.S. (3.3 Imperial) quart capacity (recommended) tank (7, figure 523) is installed in C-47 airplanes and in a limited number of C-47A airplanes—in some airplanes another tank, 2 U.S. (1.7 Imperial) quart capacity, is also installed. The larger tank is installed in the right-hand nacelle adjacent to the boiler. Mounted on this tank is a funnel, an air eliminator, and either a steam pressure gage or plug. The other tank (4, figure 523) is located in the fuselage adjacent to the radiator.

(b) REMOVAL.

1. Both tanks are removed in a similar manner. Disconnect attaching lines. Disconnect straps which hold tanks in place. Lift out tanks.

(c) MAINTENANCE REPAIR.—Leaks may be repaired by welding.

(d) ADJUSTMENTS.—Make certain that tanks are properly installed and that lines are securely connected.

(e) TEST BEFORE INSTALLATION. — The tanks are tested at the factory; therefore, a test immediately before installation is unnecessary.

(f) ASSEMBLY AND INSTALLATION.—The assembly and installation procedure is the reverse of the removal procedure.

(g) TEST AFTER INSTALLATION. – Tanks are not tested after installation.

(3) BOILER. *(See 9, figure 523.)*

(a) DESCRIPTION.—A boiler is incorporated in the right-hand engine exhaust tail pipe. This boiler is located adjacent to the main water supply tank.

(b) REMOVAL AND DISASSEMBLY.

1. Remove three bolts from universal joint (between collector ring and tail pipe).

2. Collapse forward universal joint and remove. Leave attached to collector ring.

3. Disconnect steam flange.

4. Remove water inlet line.

5. Disconnect two links just forward of station 200 3/8.

6. Remove two bolts which go through fire wall.

7. Remove four bolts in fitting at fire wall.

8. Hold up front end of tail pipe by hand and disconnect rear link.

9. Lower tail pipe and boiler assembly.

10. Remove boiler from tail pipe assembly.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged boilers are to be replaced rather than repaired.

(d) ADJUSTMENT.—Boilers do not require adjustment.

(e) TEST BEFORE INSTALLATION.—Boilers are tested at the factory; therefore, a test immediately before installation is unnecessary.

(f) ASSEMBLY AND INSTALLATION.—Reverse the removal and disassembly procedure.

(g) TEST AFTER INSTALLATION.—Boilers are not tested after installation.

(4) RADIATOR *(See 1, figure 523.)*

(a) DESCRIPTION.—The radiator is located in the fuselage above and left of the companionway. Steam from the boiler passes into this radiator, is condensed into water, and then is drained back into the boiler and the tanks. The heat from the radiator is picked up by the air flowing through the radiator cores and is sent to the various outlets.

(b) REMOVAL AND DISASSEMBLY.

1. Disconnect lines.

2. Disconnect radiator from attaching ducts.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged radiators should be replaced rather than repaired.

(d) ADJUSTMENTS. – The radiator requires no adjustments.

(e) TEST BEFORE INSTALLATION. – The radiator is tested at the factory; therefore, a test before installation is unnecessary.

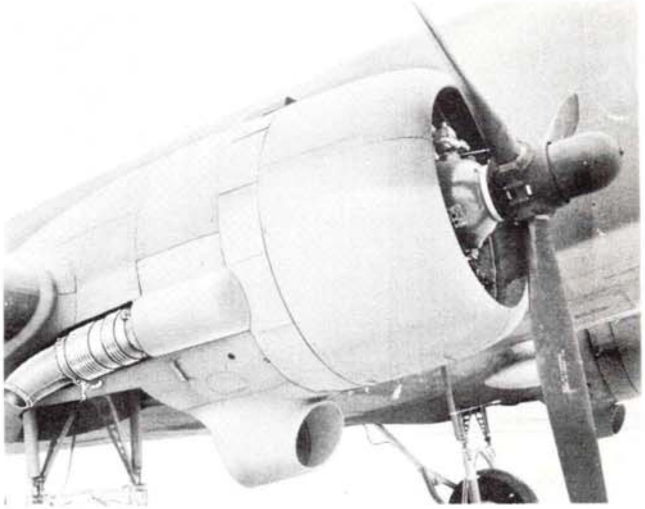


Figure 525—Boiler Installed

(f) ASSEMBLY AND INSTALLATION.—Reverse the removal and disassembly procedure.

(g) TEST AFTER INSTALLATION.— Radiators are not tested after installation.

(5) CONTROLS. *(See figure 523.)*

(a) DESCRIPTION.— C-47 and C-47A steam heating and ventilating controls are installed to perform three different functions. One control, which actuates the mixing valve, regulates the air temperature; another control, linked to the shut-off valve, controls the steam to the radiator; the remaining controls regulate the flow of air from the duct outlets to the compartments. One control, connected to the intake valve, performs a dual function in that, by controlling the flow of air from the scoops into the fuselage ducts, it also acts as a temperature regulator. All controls are adjacent to, and integral with, the valve which they actuate, with the exception of the steam shut-off valve control which employs a rod linkage.

(b) REMOVAL AND DISASSEMBLY.

1. Controls integral with the valve which they actuate are removed when the duct, encasing the valve, is removed. Refer to paragraph 18.*b*.(8), this section. The plunger-type control may be detached from the shut-off valve by removing the bolt which connects the plunger rod clevis to the shut-off valve and then removing the plunger from its holding bracket.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged controls should be replaced rather than repaired.

(d) INSTALLATION. – Reverse the removal and disassembly procedure.

(e) TEST AFTER INSTALLATION. – Check to see that all controls operate properly. Make adjustments when necessary.

(6) AIR ELIMINATORS.
(See 3 and 6, figure 523.)

(a) DESCRIPTION.—An air eliminator is installed on the water supply tank, and another in a line adjacent to the radiator. They are designed to remove air from the system prior to the formation of steam. A thermal element within the air eliminator closes the valve when steam arises.

(b) REMOVAL.— Unscrew the air eliminator from its point of connection.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Air eliminators should be replaced rather than repaired.

(d) ASSEMBLY AND INSTALLATION.—Reverse the removal procedure.

(e) TEST AFTER INSTALLATION.—Prior to formation of steam, place hand over air eliminator and check to see that hot air is escaping. The air eliminator should close when steam is formed.

(7) STEAM TRAPS. *(See 11, figure 523.)*

(a) DESCRIPTION.—A steam trap is located in the nacelle, and in the fuselage adjacent to the radiator. On some airplanes, however, the latter steam trap is not installed. They are designed to allow water, formed by the condensation of steam, to flow back to the boiler and the supply tank. A bellows-type metal thermal element within the steam trap causes a valve to open when water is passing through, but will close at the higher temperature of steam, thus preventing it from escaping.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.—Disconnect lines and four attaching bolts.

2. DISASSEMBLY.—It is inadvisable to disassemble steam traps.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Steam traps should be replaced rather than repaired.

(d) INSTALLATION.— Reverse the removal procedure.

(8) VALVES. *(See figure 523.)*

(a) DESCRIPTION.—Three different types of valves are used in the steam heating and ventilating system: drain valves, a pressure relief valve, and valves of the butterfly type which are installed within ducts. These latter valves are actuated by the controls. Refer to paragraph 18.*b*.(5), this section.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. The pressure relief valve and drain valves are removed by disconnecting them from the lines to which they attach.

b. Valves within ducts are removed when the duct is removed. Refer to paragraph 18.*b*.(8), this section.

2. DISASSEMBLY.—It is inadvisable to disassemble valves.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Valves should be replaced rather than repaired.

(d) INSTALLATION. — Reverse the removal procedure.

(9) STEAM PRESSURE REGULATOR.
(See 8, figure 523.)

(a) DESCRIPTION. — A diaphragm-type pressure regulator is located adjacent to the boiler and the water supply tank. It functions to prevent steam pressure from exceeding 30 psi.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Remove bolts which hold regulator to bracket.

b. Disconnect regulator from attaching lines.

2. DISASSEMBLY.

a. Remove bolts attaching two sections of regulator together.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Steam pressure regulators should be replaced rather than repaired.

(d) ADJUSTMENT.— Steam pressure regulators are adjusted at the factory and should not require adjustment before installation. If, after the test preceding installation, need for adjustment is evident, an adjustment set screw may be used to normalize the pressure.

(e) TEST BEFORE INSTALLATION.— If a test stand is available, regulators should be tested to see that they open at a pressure of 30 psi.

(f) ASSEMBLY AND INSTALLATION.—Reverse the removal and disassembly procedure.

(10) STEAM PRESSURE GAGE.
(See 2, figure 523.)

(a) DESCRIPTION.—A steam pressure gage is installed on the supply tank in some airplanes; in others it is installed in a line adjacent to the radiator. The gage is of the bourdon type and is provided with a dial which is calibrated from 0 to 60 psi.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.— Disconnect attaching lines and remove gage.

2. DISASSEMBLY.—Disassembly of the gage is inadvisable.

(c) MAINTENANCE REPAIR OR REPLACEMENT. — Steam pressure gages should be replaced rather than repaired.

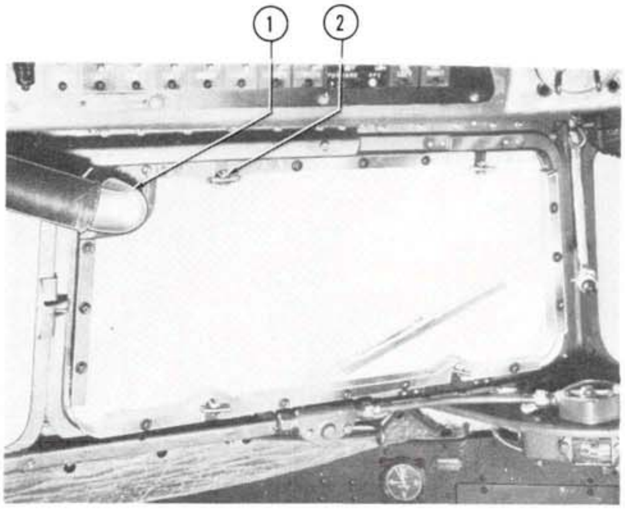


Figure 526—Windshield Defroster Shield Installed

1. Hot Air Connection to Windshield
2. Latch

(d) TEST BEFORE INSTALLATION. – If a test stand is available, the gage should be tested for correct dial reading.

(e) INSTALLATION. – Reverse the removal procedure.

(11) WINDSHIELD DEFROSTING SHIELDS. *(See figure 526.)*

(a) DESCRIPTION.—Two windshield defrosting shields shipped as loose items, may be installed inside the main front windshields. Hot air from the heating and ventilating system is directed into the space between the windshields through an inlet on one side. The hot air flows the entire length of a windshield and out the other side, thus preventing frost formation.

(b) REMOVAL.—Turn four latches and remove emergency defrosting windshield.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged windshield defrosting shields should be replaced rather than repaired.

(d) INSTALLATION. – Reverse the removal procedure.

(12) OUTLETS, DUCTS, LINES, HOSE, INSULATION. *(See figure 523.)*

(a) DESCRIPTION. – Fuselage compartment outlets are as follows: radio operator's outlet, pilot's compartment foot warmer outlets, main cargo duct outlets, pilot's hand warmer outlets, and the outlets which direct hot air between the windshield defrosting shields and the front main windshields. The first three outlets are contained in ducts, the latter outlets are found in flexible hose. All steam ducts consist of Monel metal or, on some airplanes, of corrosion-resistant steel. Air ducts are constructed of aluminum alloy. On some airplanes, however, the main cargo duct is constructed of plywood. Insulation throughout consists of asbestos covering, or Stonefelt.

(b) REMOVAL.—Disconnect ducts, lines, and hose, at joints. Work from component parts in logical manner so as to facilitate reinstallation.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Lines, ducts, hose, and insulation, should be replaced rather than repaired.

(d) INSTALLATION. – Reverse the removal procedure.

c. HOT-AIR TYPE HEATING AND VENTILATING SYSTEM. (As installed on some airplanes.) *(See figure 527.)*

(1) GENERAL.—This type hot air heating and ventilating system consists of two exchangers (11 and 101, figure 527), two mixing chambers (47 and 91, figure 527), four critical temperature warning lights (27 and 56, figure 527), two critical temperature thermoswitches (103, figure 527), two windshield defrosting shields, which act as baffles for outer windshield defrosting, and necessary scoops, ducts, tubing, hose, outlet valves, controls and control linkages. The system operates as follows: Air from without the airplane enters the two muff-type heat exchangers (one mounted on each engine exhaust tail pipe), is heated by the exhaust tail pipes, and then is routed from each exhaust tail pipe to the applicable air mixing chamber (47 and 91, figure 527 and figure 532). Here heated air, and the air which enters through scoops at the belly of the fuselage are mixed in the proportions necessary to regulate the temperature of the air flow throughout the airplane. Air is ducted to the following places in the airplane: pilot's foot warmer outlets (57 and 64, figure 527, and figure 534), pilot's hand warmer outlets (3 and 5, figure 527, and figure 539), windshield defroster outlets (2, figure 527), astrodome outlet (14, figure 527 and 4, figure 540), navigator's outlet (92, figure 527 and 1, figure 536), navigator's hand warmer outlet (90, figure 527 and 2, figure 536), radio operator's outlet (17, figure 527 and 2, figure 535), radio operator's hand warmer outlet (15, figure 527 and 1, figure 535), and the main cargo duct outlets. In addition there are two emergency spill valve outlets, one in each nacelle. Controls regulating outlet openings are installed, in some cases adjacent to outlet openings; the others are installed in a control box, located on the floor aft of the radio operator's chair. The five controls located within the box regulate the right-hand emergency spill valve (42, figure 527), the left-hand emergency spill valve (102, figure 527), the left-hand mixing chamber (5, figure 527), right-hand mixing chamber (47, figure 527), and the cross-feed (bypass) control (79, figure 527 and 5, figure 542) for single engine operation. The first three controls have a flexible push-pull linkage to the applicable outlet valves; the other two have rod link-

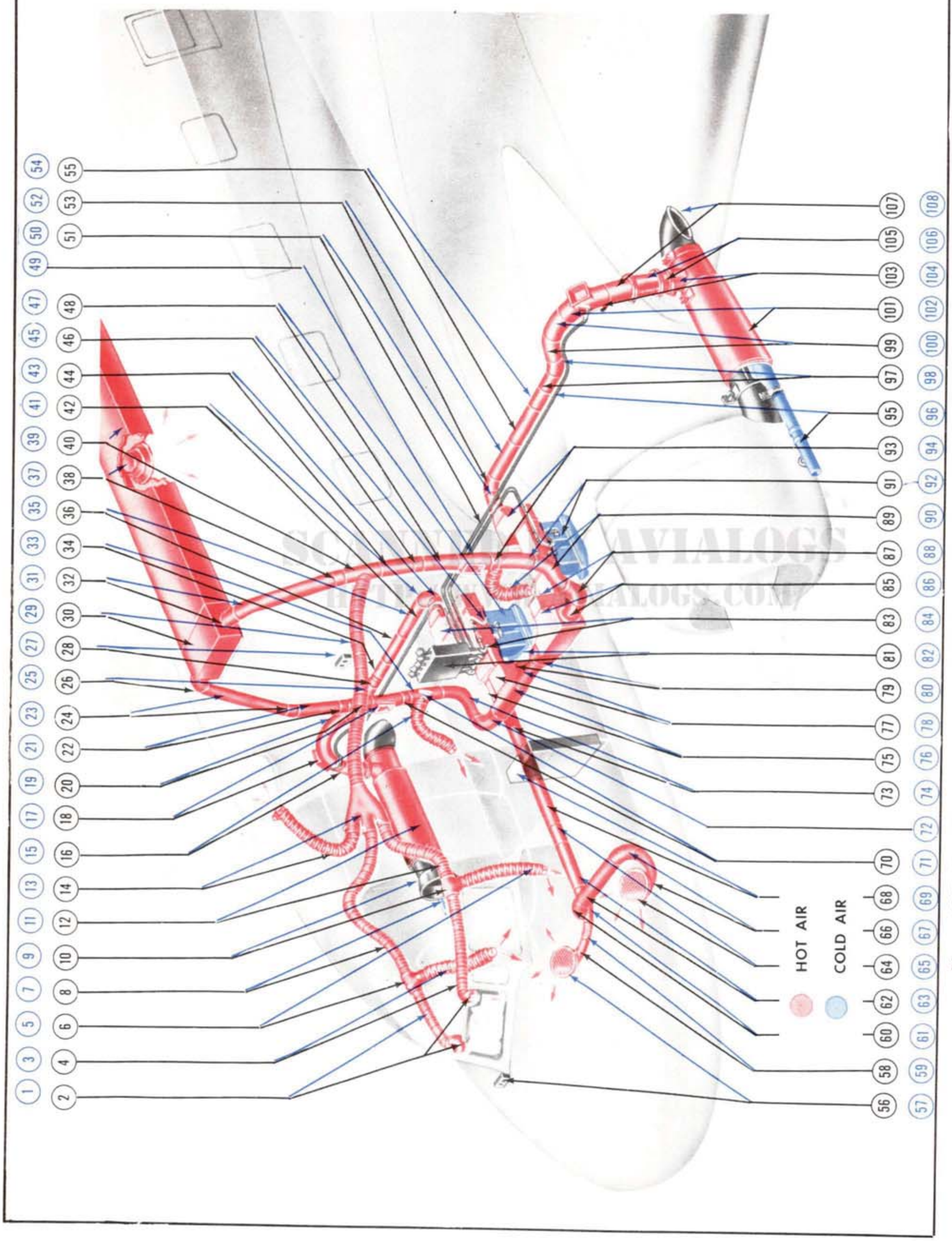

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
HOT AIR
COLD AIR

Figure 527—Hot Air Heating and Ventilating System (As Installed on Some Airplanes)

KEY TO FIGURE 527

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	2141690-10	Tube	1
2		Outlets to Windshield Defroster Shield	2
3	2141689	Pilot's Handwarmer Flexible Hose	1
4	2141690-10	Tube	1
5	2141689	Copilot's Handwarmer Flexible Hose	1
6	4141433-1	Valve Control to Pilot's Handwarmer Flexible Hose and Windshield	1
7	4142360	Muff-Type Heat Exchanger Air Scoop Assembly	1
8	2141690-8	Hose	1
9		Tail Pipe Exhaust Assembly—Integral With Heat Exchanger	1
10	4141433	Valve Control to Copilot's Handwarmer Flexible Hose and Windshield	1
11	5171474-1	Muff-Type Heat Exchanger Assembly RH	1
12	2141690-6	Hose	1
13	4142169	4-way Branch Duct	1
14	2141689	Flexible Hose to Astrodome	1
15	2141689	Radio Operator's Handwarmer Flexible Hose	1
16	4142467	Duct	1
17	5142199-1*	Outlet to Radio Operator's Compartment	1
18	5141807-1	RH Emergency Spill Valve Assembly	1
19	4141863	Duct	1
20	2142717-2	Duct	1
21	2142717-8	Duct	1
22	2142844	Elbow	1
23	2142717-6	Duct	1
24	2142842	Elbow	1
25	4141733	Duct	1
26	2142843	Elbow	1
27	1505-1	Critical Temperature Warning Lamps	2
28	4141806-1	Elbow	1
29	2141690-2	Tube	1
30	5202330	Connection	1
31	2142717-6	Duct	1
32	2142717-2	Duct	1
33	4141675-1*	Outlet	1
34	4141766-1	Duct	1
35	2141764	Duct	1
36	2141754	Duct	1
37	4113194	Diffuser	4
38	2142842	Elbow	1
39	5142300	Main Cargo Duct Assembly	1
40	4142168	Branch Duct	1
41	2141756	Elbow	1
42	5142851-4	Control Assembly to RH Emergency Spill Valve	1
43	4141976	Connector	1
44	2142717-4	Duct	1
45		Control Linkage to RH Mixing Chamber (See figure 542, also)	
	AN486-3	Clevis	2
	AN316-4r	Nut	2
	1142250-2	Rod	1
	2142174	Lever Assembly	1
	1142405	Link	2
46	2142844	Elbow	1
47	5141983-1	Mixing Chamber RH	1
48	2142717-2	Duct	1
49	5142199	Navigator's Heat Outlet	1
50	2142845	Elbow	1
51	4142837-2	Control Assembly to LH Mixing Chamber	1

KEY TO FIGURE 527 (Cont'd)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
52	2141763	Duct	1
53	2141757	Elbow	1
54	2141754	Duct	1
55	2141755	Duct	1
56	1505-1	Critical Temperature Warning Lamps	2
57	4142151	Pilot's Footwarmer Outlet	1
	2113956	Screen	1
58	4142076	Duct	1
59	4142016	Elbow	1
60	4142069	Elbow	1
61	5142068	Splitter	1
62	2142097	Duct	1
63	2142259-8	Duct	1
64	4142151	Copilot's Footwarmer Outlet	1
	2113956	Screen	1
65	4142083	Elbow	1
66	4142098	Elbow	1
67	4142070	Elbow	1
68	2142259-10	Duct	1
69		Windshield Stowage Container (Ref section IV, paragraph 14.*d*.(20)(*j*).)	1
70	2142845	Elbow	1
71	4141675-1	Valve Control to Radio Operator's Handwarmer	1
72	4141975	Elbow	1
73	4142084	Duct	1
74	4141986	Elbow	1
75	4141959	Tee	1
76	4142217	Tee	1
77	5141976	Elbow	1
78	2142259-12	Duct	1
79		Refer to figure 542 for Control Linkage to bypass (Crossfeed) Valve	
80	4141962	Reducer	1
81	5142148	Box Assembly	1
82	5141710	Mixing Chamber Scoop Assembly LH	1
	5141710-1	Mixing Chamber Scoop Assembly RH	1
83		Control Linkage to Bypass (Crossfeed) Valve. Refer also to figure 542	1
84	4141963	Connection	1
85	4141970	Reducer	1
86	4142042	Tee	1
87	4141967	Elbow	1
88	4142001	Offset	1
89	4141984	Elbow	1
90	2141689	Navigator's Hand-Warmer Flexible Hose	1
91	5141983	Mixing Chamber LH	1
92	4141675	Outlet to Navigator's Compartment (Flexible Hose Attached)	1
93	2142845	Elbow	1
94	4141981	Connection	1
95	4142360	Muff-Type Heat Exchanger Air Scoop Assembly LH	1
96	5142840-4	Control Assembly to LH Emergency Spill Valve	1
97	4141766	Duct	1
98	4141806	Elbow	1
99	4141733	Duct	1
100	4141863	Duct	1
101	5171474	Muff-Type Heat Exchanger LH	1
102	5141807	LH Emergency Spill Valve Assembly	1
103	Fenwal Type 732-1F	Critical Temperature Thermo-Switch	2

KEY TO FIGURE 527 (Cont'd)

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
104	2142357	Clamp	2
105	2142448	Adapter	2
106	4142295	Tube	2
107	4142467	Duct	1
108		Engine Tailpipe Exhaust (Heat Exchanger is Integral with Tailpipe Exhaust—Weld Assembly)	2

* Items 17 and 33 are reversed on some airplanes. Installation should be made as illustrated.

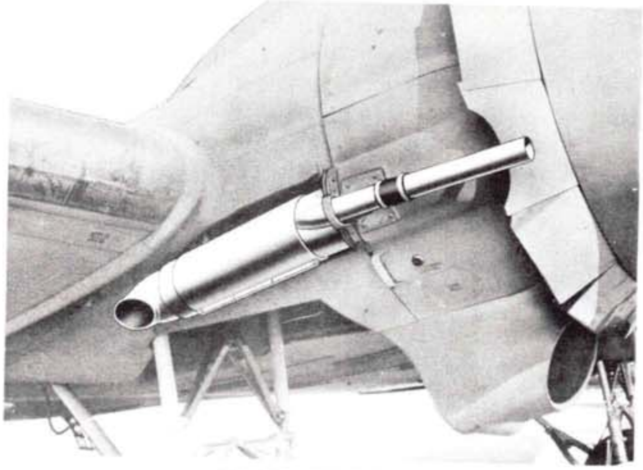


Figure 528—Heat Exchanger Installed (Hot-Air Type System)

ages. Two critical temperature thermoswitches (103, figure 527), one installed in each spill valve, light the critical temperature warning lamps when temperatures exceed 232°C (450°F). These are installed in the pilots' compartment, and the radio operator's compartment. There are two lamps in each compartment. When the left-hand thermoswitch reacts due to excessive temperature, the left-hand lamp in each compartment lights. When the right-hand thermoswitch reacts, the right-hand lamp lights. Immediately after a warning light becomes evident, the radio operator should open the applicable spill valve, thus allowing heated air to escape. When the light goes out, the spill valve may be closed again.

CAUTION

It is imperative that the pilot and the copilot, as well as the radio operator, be alert when a critical temperature warning light flashes "ON." If the radio operator fails to open the applicable emergency spill valve *immediately,* the pilot or copilot should take necessary steps to see that it is opened. It is important that no obstructions in the ducts restrict the flow of air through the exchangers at any time. If air is blocked off, excessive temperatures will prevail and the exchangers will burn out. Ventilation occurs when the mixing

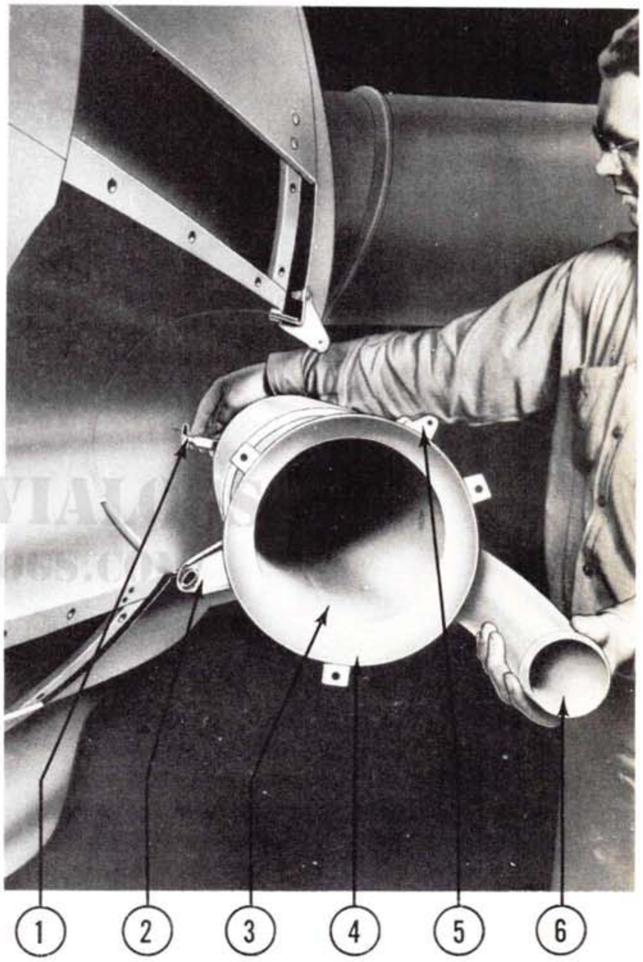


Figure 529—Installing Muff-Type Heat Exchanger

1. Side Adjustable Link Connection
2. Heat Exchanger Projection—Bolt to Fire Wall
3. Engine Tailpipe Exhaust
4. Muff-Type Heat Exchanger*
5. Top Forward Heat Exchanger Projection
6. Cold Air Intake Connection

Note: Refer also to figures 527, 544, 530 and 531.

*The muff-type heat exchanger is an integral (welded) part of the exhaust tailpipe.

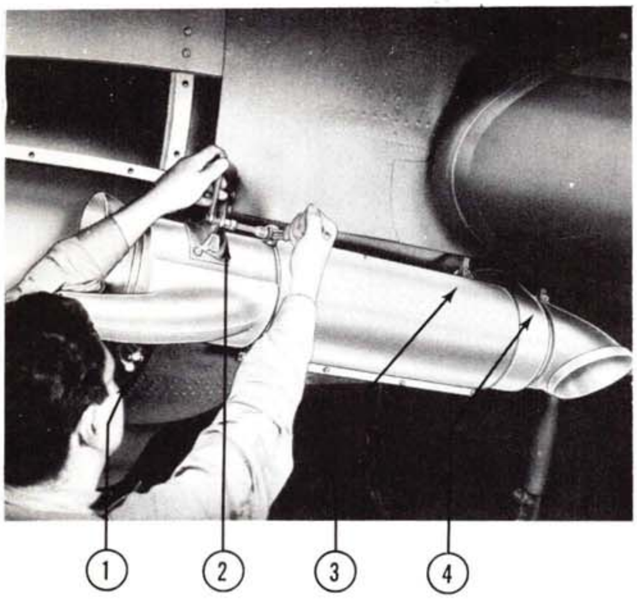


Figure 530—Installing Muff-Type Heat Exchanger

1. Attachment to Fire Wall
2. Top Front Attachment
3. Top Adjustable Link Attachment
4. Rear Adjustable Link

Note: Refer also to figures 527, 544, 530 and 531.

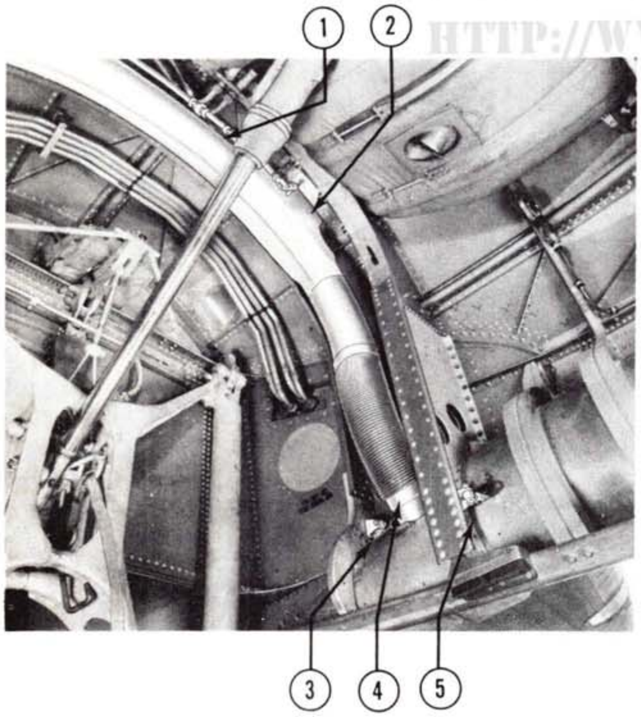


Figure 531—Nacelle Hot Air Installation

1. Push-Pull Control Assembly
2. Emergency Spill Valve
3. Adjustable Link Attachment
4. Corrosion-Resistant Steel Duct
5. Adjustable Link Attachment

Note: Refer also to figures 527 and 544.

chamber valves are in such a position as to allow outside air to enter the fuselage while at the same time preventing the entrance of heated air from the heat exchangers. The emergency spill valves should also be opened in order to prevent unnecessary heat in the nacelle sections.

(2) MUFF TYPE HEAT EXCHANGER. *(11 and 101, figure 527 and figure 528.)*

(a) DESCRIPTION. — A muff-type heat exchanger, one installed as an integral part of each exhaust tail pipe, heats the air which is ducted to the compartments within the fuselage. Operation is as follows: Outside air enters the heat exchanger through a connecting air inlet. Air within the heat exchanger is heated by the engine exhaust gases. The warm air then flows through a duct to a mixing chamber.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.—Two men should work together in order to facilitate removal of the muff-type heat exchanger. Remove bolts from brackets and links and lift exchanger from place.

2. DISASSEMBLY.—It is possible to remove only the blanket from the complete assembly, as the remainder of the heater is welded to the exhaust tail pipe.

(c) MAINTENANCE, REPAIR, REPLACEMENT AND TESTING.—Muff-type heat exchangers should be replaced rather than repaired.

(d) INSTALLATION.—Two men should work together in installing the muff-type heat exchanger. The following procedure is recommended:

1. Secure extreme aft top adjustable link (4, figure 530) to applicable bracket. Place bolt through bracket holes and link head and tighten nut against bracket.

2. Secure side adjustable link (1, figure 529) as described in *1.*, preceding.

3. Place a holding pin (2, figure 530) in top front bracket to hold assembly in place while attaching other points of connection.

4. Secure forward lower flange projection (2, figure 529) to fire wall. It may be necessary to use a pry bar to force heat exchanger assembly into position.

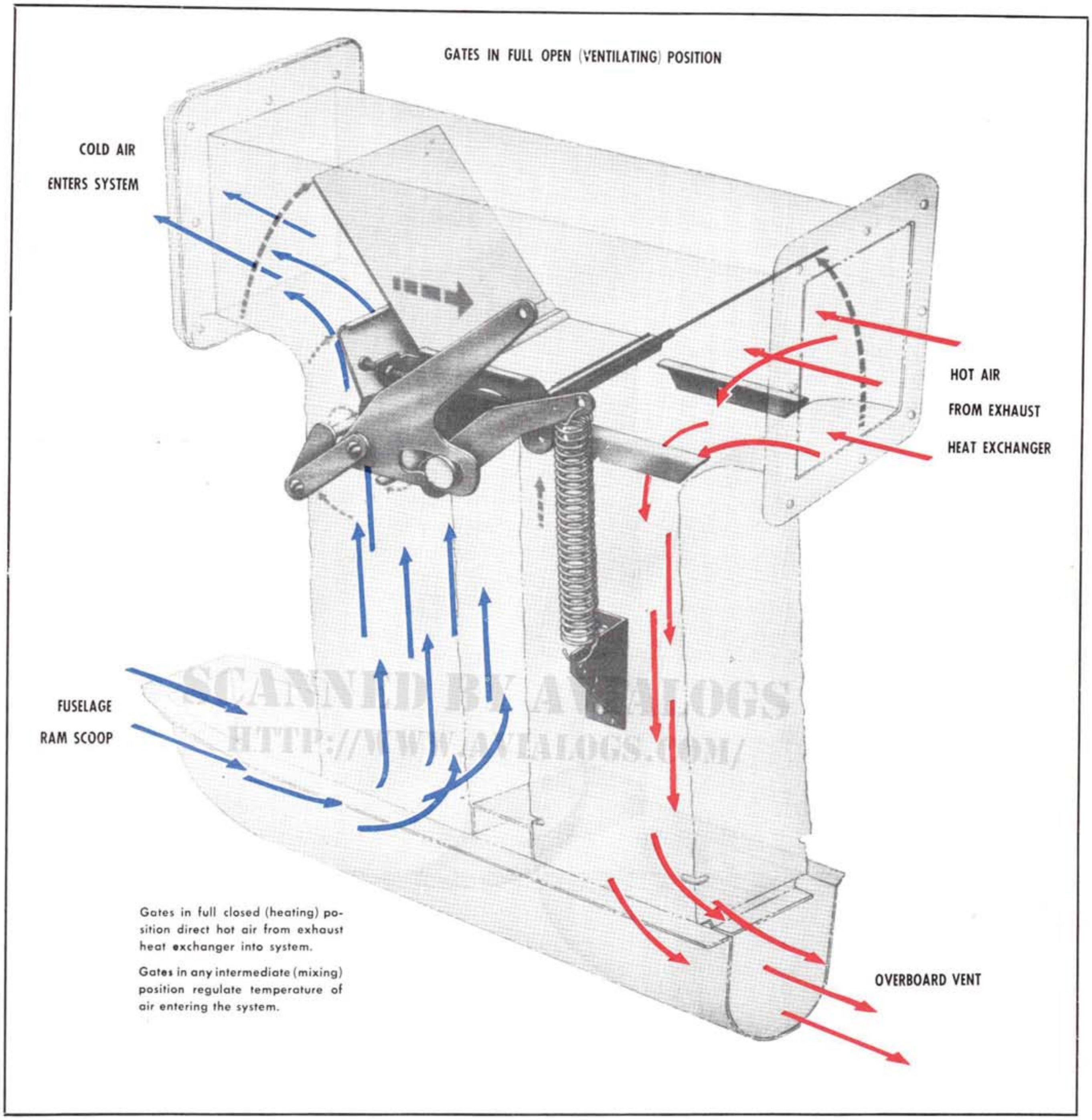
5. Remove pin from bracket (2, figure 530). Replace with AN 4-12A bolt. Five AN 960-416 steel washers should fit on bolt (in any order) between flange and side, or sides, of bracket.

6. Secure middle top adjustable link (3, figure 530) as described in *1.*, preceding.

(e) TEST.—Heat exchanger may be tested by subjecting interior passages to air pressure of 20 psi. Leakage should not exceed a rate of 9 psi an hour.

(3) MIXING VALVE ASSEMBLY (Mixing Chamber). *(See 47, figure 527 and figure 532.)*

(a) DESCRIPTION. — Two mixing chambers, one on each side of the fuselage (approximately even


GATES IN FULL OPEN (VENTILATING) POSITION
COLD AIR ENTERS SYSTEM
HOT AIR FROM EXHAUST HEAT EXCHANGER
FUSELAGE RAM SCOOP
OVERBOARD VENT

Gates in full closed (heating) position direct hot air from exhaust heat exchanger into system.

Gates in any intermediate (mixing) position regulate temperature of air entering the system.

Figure 532—Mixing Chamber Operation

with the forward end of the main cargo duct) are provided for the purpose of mixing hot and cold air in proportions necessary to maintain a desired temperature within the fuselage compartments. One mixing chamber is connected by a duct to the left-hand heat exchanger; the other is connected to the right-hand heat exchanger. At the bottom of each mixing chamber is installed an air scoop assembly. These scoop assemblies, which are located on the bottom of the fuselage, have two openings, one forward and one aft. The forward opening ducts outside air into the forward section of the mixing chamber; the aft opening ducts hot air from the aft section of the mixing chamber. A valve arrangement at the top of each vertical section of the mixing chambers permits cool air and warm air to mix in various proportions, for the purpose of achieving the desired temperature, when the attaching controls are actuated. Operation of the applicable control, between the full "HOT" or full "COLD" position, permits any proportion of cool air and hot air to be mixed. When the control is in the full "HOT" position, a maximum amount of hot air and a mini-

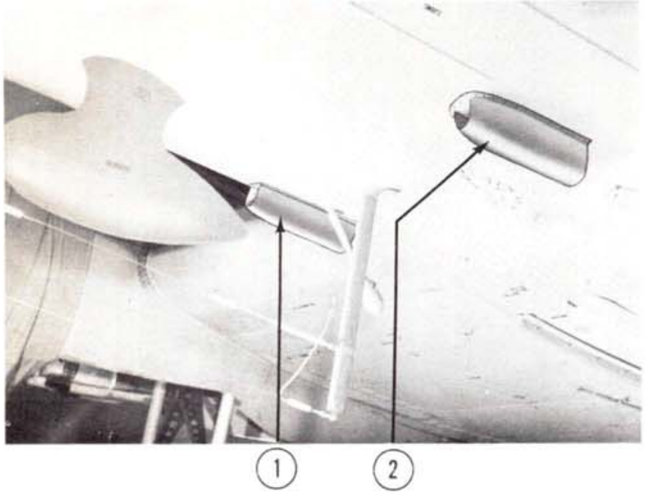


Figure 533—Air Scoops to Mixing Chambers

1. Air Intake Scoop—Right-hand Mixing Chamber (Cold Air Inlet Shown)
2. Air Intake Scoop—Left-hand Mixing Chamber (Cold Air Inlet Shown)

Note: Refer also to figures 527, 544 and 532.

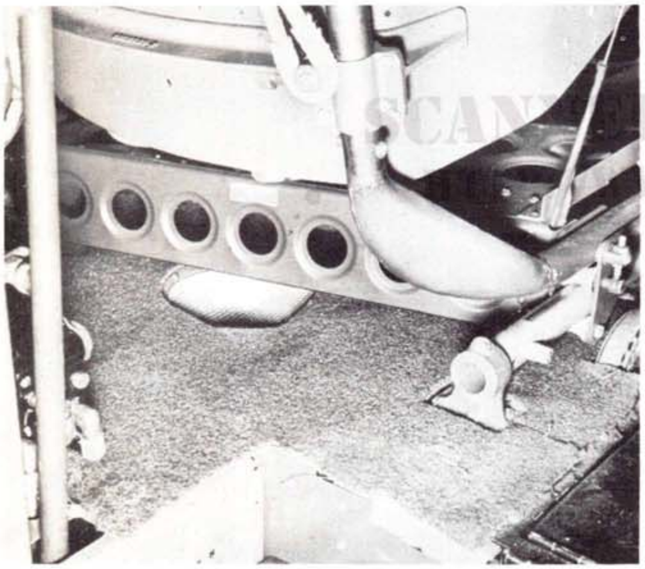


Figure 534—Pilot's Foot Warmer

mum amount of cool air is allowed to enter the fuselage compartments; in the full "COLD" position, the reverse condition is true.

(b) REMOVAL AND DISASSEMBLY.

1. Remove airplane floor above mixing chamber.

2. Disconnect ducts from mixing chamber by removing attaching screws.

3. Disconnect control linkage.

4. Disconnect mixing chamber from air scoop assembly by removing attaching screws.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Damaged mixing chambers should be re-

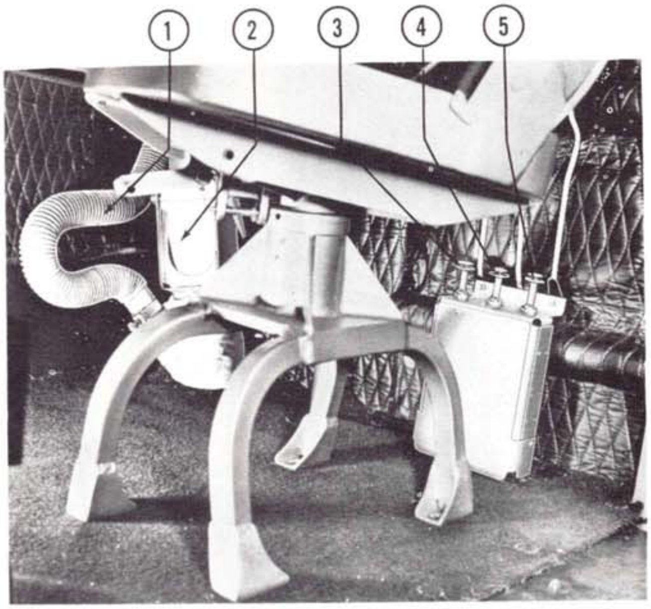


Figure 535—Hot Air System, Outlets and Controls, Radio Operator's Compartment (On Some Airplanes)

1. Flexible Hose Handwarmer Outlet
2. Warm Air Outlet
3. Right-hand Emergency Spill Valve Control
4. Left-hand Emergency Spill Valve Control
5. Left hand Mixing Chamber Control

Note: Refer also to figures 543, 546 and 547.

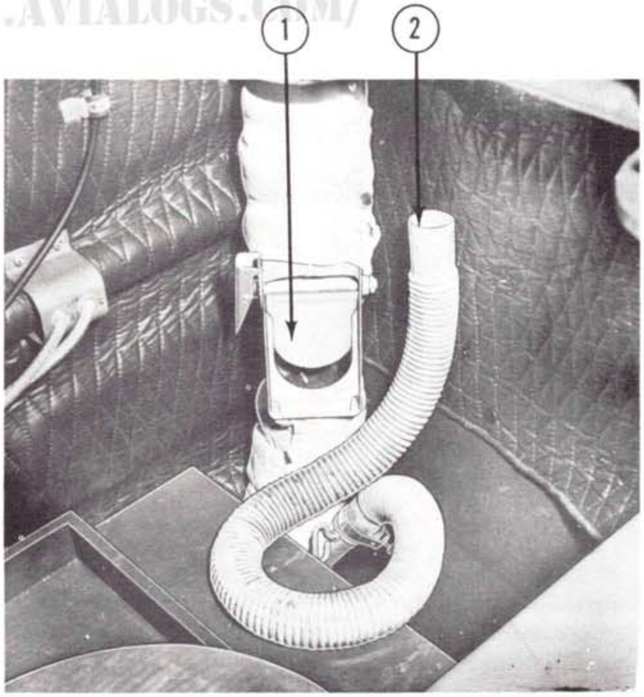


Figure 536—Hot Air System Outlets, Navigator's Compartment

1. Warm Air Outlet
2. Flexible Hose Handwarmer Outlet

Note: Refer also to figures 527 and 544.

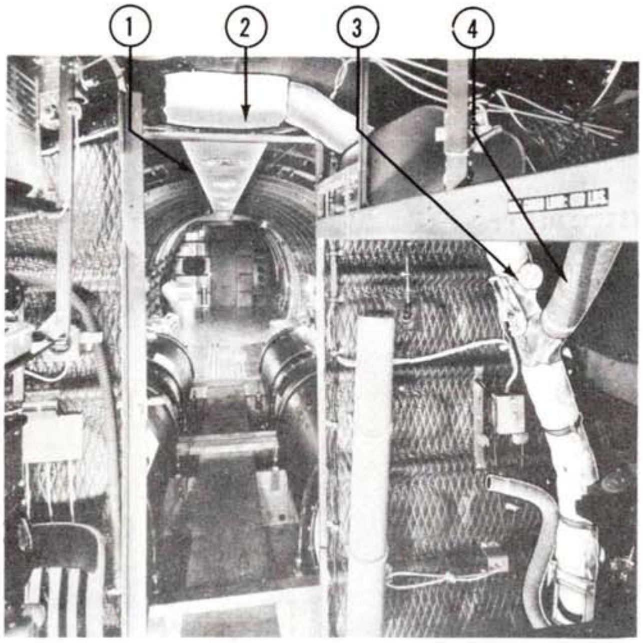


Figure 537—Hot Air System, Looking Aft (As Installed on Some Airplanes)

1. Main Cargo Compartment Duct
2. Connection
3. Hose to Electric Windshield Defroster Blower. (Plug Inserted on Some Airplanes)
4. Hose to Four-way Branch Assembly

Note: Refer also to figure 543.

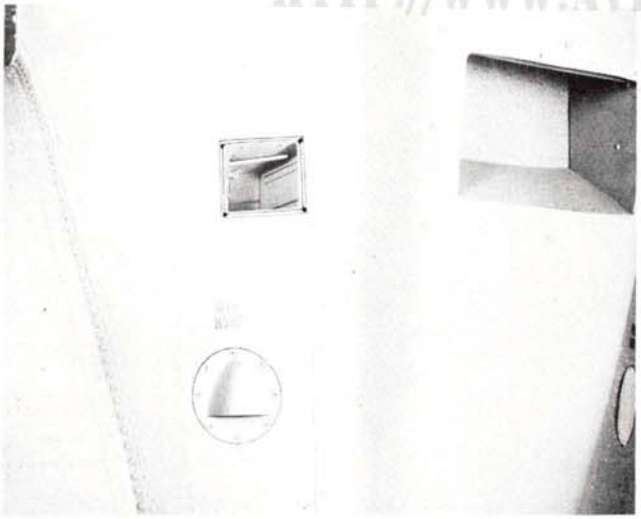


Figure 538—Emergency Spill Valve (Above Wing Hoist)

placed rather than repaired. However, if absolutely necessary, small holes may be repaired by welding.

(d) TEST BEFORE INSTALLATION.—Check valve action by hand before installing mixing chamber in airplane.

(e) ASSEMBLY AND INSTALLATION.—Reverse the removal and disassembly procedure.

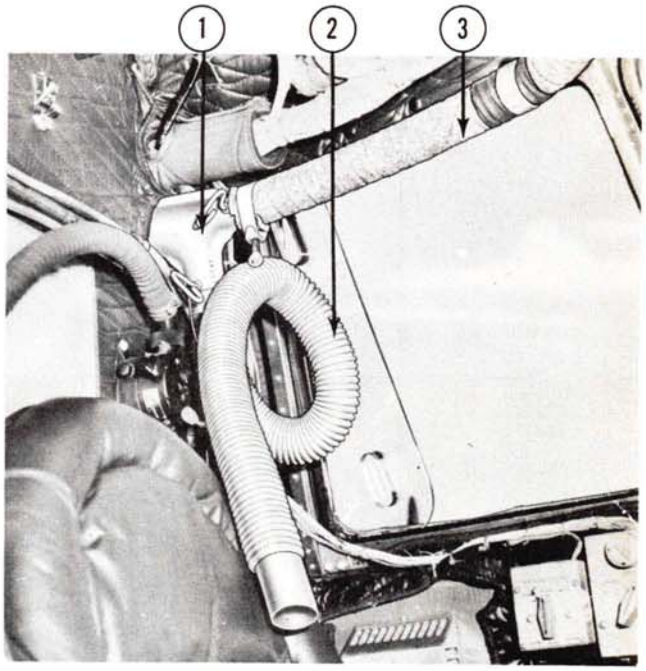


Figure 539—Hot Air System Components, Above Pilot's Seat

1. Outlet Valve Controls
2. Flexible Hose Warm Air Outlet
3. Hose to Windshield

Note: Refer also to figures 527 and 544.

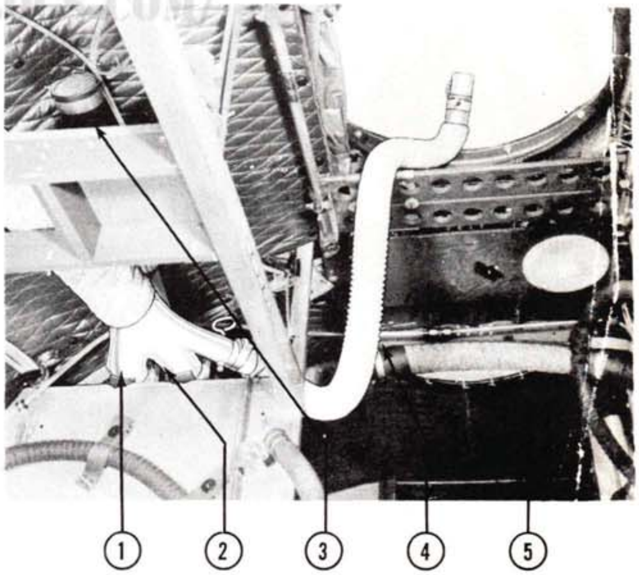


Figure 540—Hot Air System Components Above Navigator's Compartment and Companionway

1. Four-way Branch Outlet to Windshield
2. Four-way Branch Outlet to Windshield
3. Hose to Electric Windshield Defroster Blower (Plug Inserted on Some Airplanes)
4. Flexible Hose to Astrodome
5. Defroster Hose Leading to Windshield

Note: Refer also to figure 543.

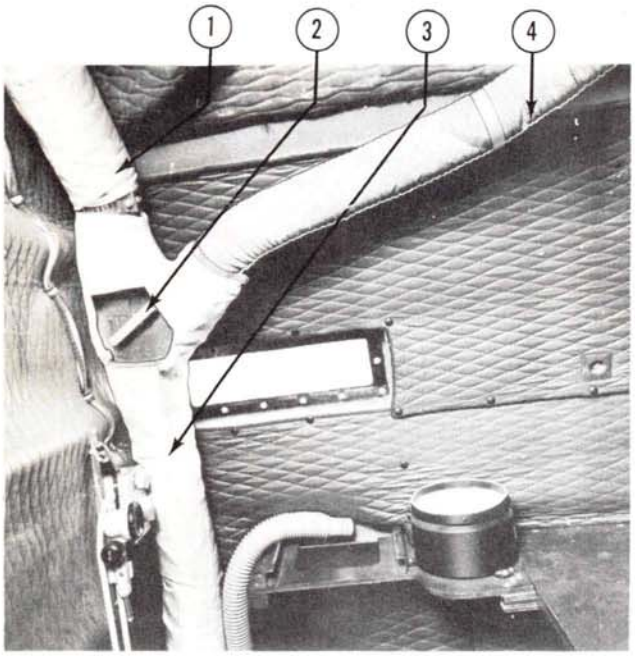


Figure 541—Hot Air System Components, Navigator's Compartment (On Some Airplanes)

1. Duct to Main Cargo Duct
2. Outlet Valve Control
3. Duct to Outlet
4. Duct to Windshield

Note: Refer also to figure 527.

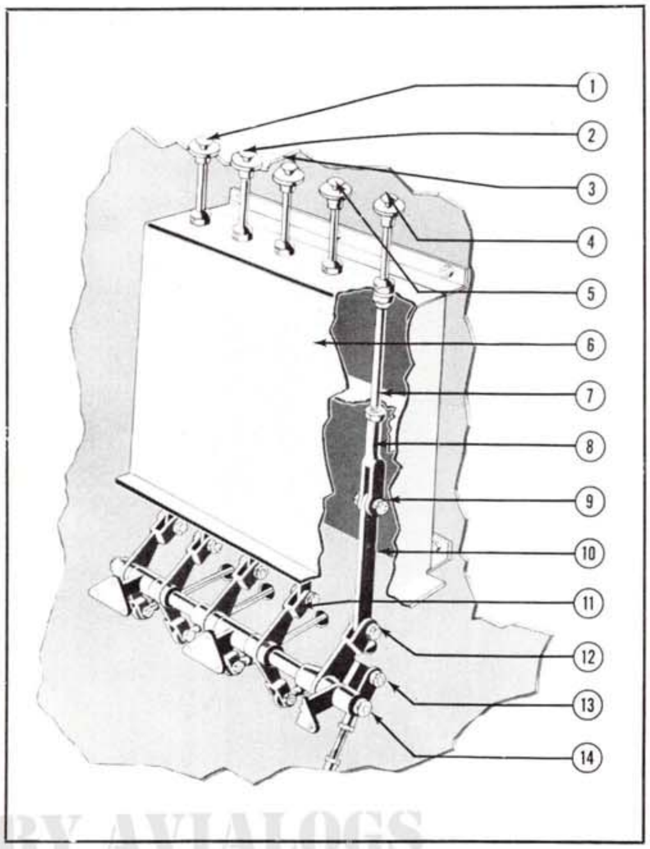


Figure 542—Control Box, Five Button Plunger

KEY TO FIGURE 542

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1		RH Nacelle Emergency Spill Valve Control	1
2		LH Nacelle Emergency Spill Valve Control	1
3		LH Mixing Chamber Control	1
4		Bypass (Cross-feed) Control	1
5		RH Mixing Chamber Control	1
6	5142148	Box Assembly	1
7	2142354	Lever Assembly	5
8	AN486-4	Clevis	5
	AN316-4r	Nut	5
9	AN23-10	Bolt	5
	AN320-3	Nut	5
10	1142096	Link Assembly	5
11	4142143	Lever Assembly	4
12	AN23-10	Bolt	5
	AN320-3	Nut	5
13	4142158	Lever Assembly	1
	AN486-3	Clevis	1
	AN316-4r	Nut	1
	1142250-4	Rod	1
	AN486-4	Clevis	1
	AN316-4r	Nut	1
14	1142223	Shaft	1
	AN310-D5	Nut	2

Note: Refer also to figure 527.

(4) DUCTS, FLEXIBLE HOSE, OUTLETS. *(See figure 527.)*

(a) DESCRIPTION. – Ducts throughout are composed of weldable aluminum with the exception of the corrugated tube duct at the aft end of each muff type heat exchanger. Duct outlets are as follows: pilot's foot warmer heat outlets (57 and 64, figure 527 and figure 534), radio operator's heat outlet (17, figure 527), navigator's heat outlet (49, figure 527), the main cargo duct outlets (37, figure 527), and the emergency spill valve outlets (18 and 102, figure 527 and figure 526). The latter outlets, however, serve only to vent excess hot air into the atmosphere and do not conduct air into the fuselage compartments. Flexible hose outlets are used in places where it is necessary to vary the position of the heat outlets. Hose outlets are as follows: pilots' flexible hose outlets (3 and 5, figure 527 and figure 539), windshield defroster outlets (2, figure 527), astrodome defroster flexible hose (14, figure 527 and 4, figure 540), radio operator's flexible hose (15, figure 527 and 535), and the navigator's flexible hose (90, figure 527 and 2, figure 536).

(b) REMOVAL.

1. Work through access holes or remove floors where necessary. Remove insulation from around ducts. Disconnect ducts and hose at joints. Remove in a logical sequence and number so as to facilitate reinstallation.

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Damaged ducts and hose should be replaced rather than be repaired. However, in an emergency, small holes in ducts may be welded and hose may be wrapped with tape.

(d) INSTALLATION. – Reverse the removal procedure. Fit ducts together with Hi-Seal sealing compound.

(e) TEST AFTER INSTALLATION. – Air should be forced through the heating and ventilating system by a blower in order to remove obstructions. Check ducts by hand for large holes.

(5) CONTROLS AND VALVES. *(Figures 527, 542, and 546.)*

(a) DESCRIPTION.–There are three types of controls used: those controls (42, 51, and 96, figure 527) which consist of a flexible push-pull linkage between the control plunger and the applicable valve; those controls (45 and 79, figure 527) which consist of a mechanical linkage between the plunger and the applicable valve; and those controls in which the control is adjacent to, and integral with, the applicable valve. Controls of the first type attach to the right-hand spill valve, the left-hand spill valve, and the left-hand mixing chamber. Controls of the second type attach to the right-hand mixing chamber and to the bypass valve. Plungers for all five controls, however, are installed in a box (figure 542) which is located in the radio operator's compartment. The third type of controls (local controls) are located adjacent to the outlets. (Refer to paragraph 18.*c.*(4), this section.)

The controls attached to the mixing chambers directly affect the temperature of the air within the fuselage compartments; the other controls are for the purpose of regulating the flow of air through the outlets. Valves throughout the entire heating and ventilating system are of the butterfly, or flap type.

(b) REMOVAL.

1. Removal of all controls, with the exception of those integral with valves, will be obvious upon examination. No special tools are required. Begin at the valve and work toward the point of control. Number parts in order to facilitate reinstallation. Controls integral with valves should not be removed—rather, the entire duct assembly should be replaced. (Refer to paragraph 18.*b.*(8) this section.)

(c) MAINTENANCE REPAIR OR REPLACEMENT.–Controls should be replaced rather than repaired.

(d) INSTALLATION. – Reverse the removal procedure.

(e) TEST AFTER INSTALLATION. – Check all controls for freedom of movement, correct attachment and throw.

(6) THERMOSWITCHES AND WARNING LIGHTS. *(See figure 527.)*–Two critical temperature thermoswitches, one installed in each emergency spill valve, energize critical temperature warning lamps when temperatures exceed 232°C (450°F). These lights are installed in the pilots' compartment, and the radio operator's compartment. There are two lamps in each compartment. A lighted warning lamp warns the crew that the spill valve should be opened immediately. For other information pertaining to the critical temperature thermoswitches and the critical temperature warning lights, refer to paragraph 14.*k.*(12) this section.

(7) EMERGENCY DEFROSTER WINDSHIELDS.–(Refer to paragraph 18.*b.*(11), this section.)

d. HOT-AIR TYPE HEATING AND VENTILATING SYSTEM. (As installed in some airplanes.) *(Figures 543 and 548.)*

(1) GENERAL.–This hot-air type system differs from the other hot-air type system (refer to paragraph 18.*c.*, this section) in the following respects: The cross feed (bypass) duct (figure 527) for single engine operation and the right-hand duct have been removed. An electric defrosting blower has been added for windshield and astrodome defrosting, during emergency or ground operation. A duct for the ducting of heat to the automatic pilot servo unit has been added. The control box, on the floor behind the radio operator's compartment, has been revised to include only the controls regulating the two emergency spill valves (19 and 48, figure 543) and the left-hand mixing chamber (81, figure 543). The cross-feed (bypass) control

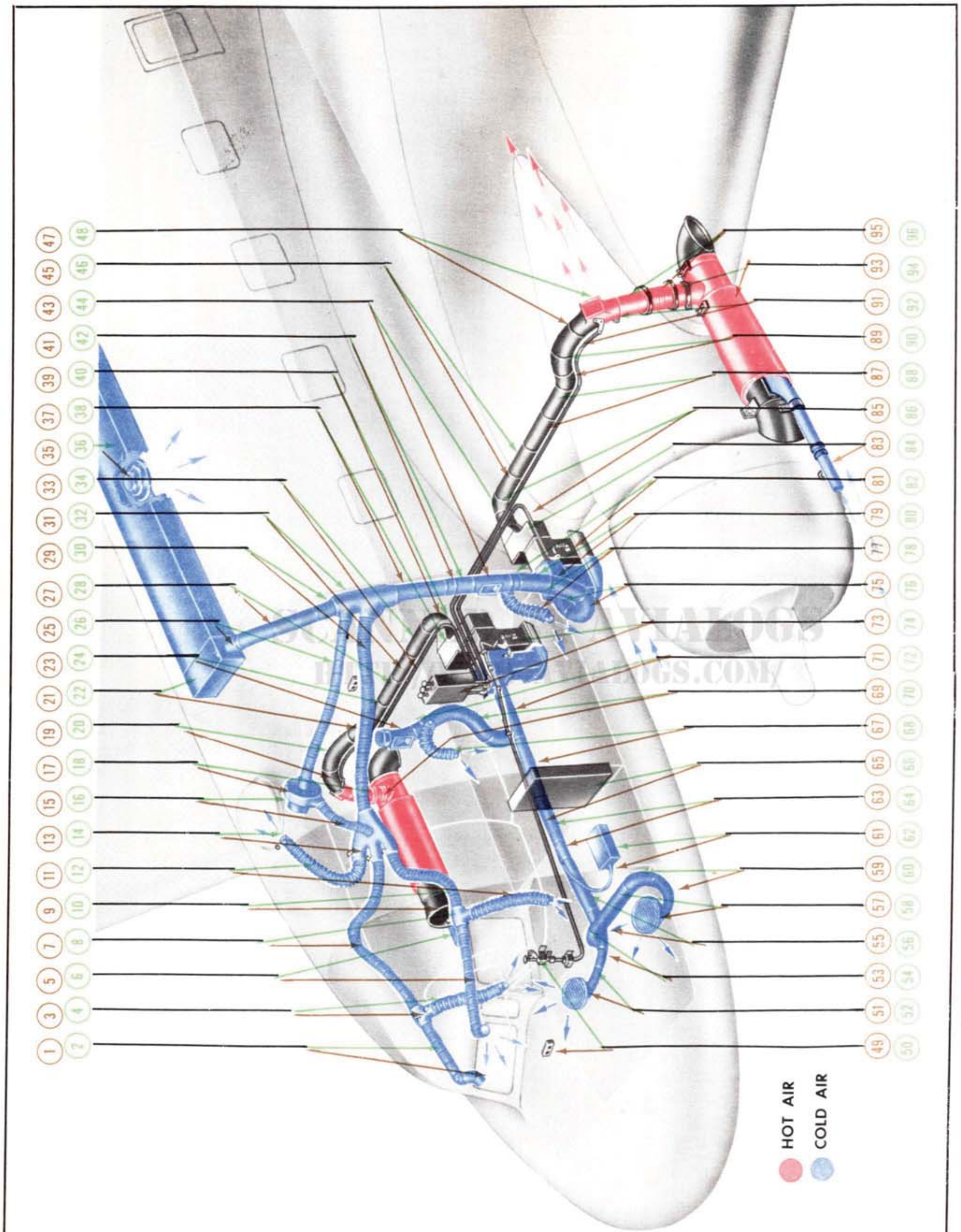

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
HOT AIR
COLD AIR

Figure 543—Hot Air Heating and Ventilating System (As Installed on Some Airplanes)

KEY TO FIGURE 543

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1		Windshield Hot Air Outlets	2
2	2141690-10	Tube	2
3	4141433-1	Valve Outlet Control to Copilot's Handwarmer and Windshield	1
4	2141689	Hose	1
5	2141690-10	Tube	1
6	4142360	Air Intake Scoop to Muff-Type Heat Exchanger	1
7	2141690-8	Tube	1
8	4141433	Valve Outlet Control to Pilot's Handwarmer and Windshield	1
9	5171474-1	Muff-Type Heat Exchanger RH	1
10	2141690-6	Tube	1
11	2141689	Hose	1
12	2141689	Hose	1
13	4202716	Duct	1
14	1142222	Outlet to Astrodome	1
15	2141690-16	Tube	1
16	CM-025-4-1/2-CC	Blower Assembly	1
17	1202710	Reducer	1
18	4142295	Tube	1
19	5141807-1	Emergency Spill Valve RH	1
20	4141863	Duct	1
21	4141733	Duct	1
22	5202330	Connection	1
23	5202633	Outlet to Radio Operator's Compartment	1
24	4141806-1	Elbow	1
25	2142843	Elbow	1
26	2141690-14	Tube	1
27	2142717-6	Duct	1
28	4141766-1	Duct	1
29	2141690-2	Tube	1
30	2142842	Elbow	1
31	2141754	Duct	1
32	5202725	Defroster and Handwarmer Valve Assembly	1
33	5142851-4	RH Emergency Spill Valve Control Assembly	1
34	2141764	Duct	1
35	4113194	Main Cargo Compartment Duct Grill (Diffusers)	4
36	5142300	Main Cargo Compartment Duct	1
37	2142717-10	Duct	1
38	4141963	Connection	1
39	2141756	Elbow	1
40	4141979	Connector	1
41	2142844	Elbow	1
42	2142717-2	Duct	1
43	5142199-1	Navigator's Outlet	1
44	4141979	Connector	1
45	2141763	Duct	1
46	2141755	Duct	1
47	4141863	Duct	1
48	5141807	Emergency Spill Valve LH	1
49	1505-1	Critical Temperature Warning Lamp	4
50	2142354	Lever Assembly	1
51	4142151	Copilot's Footwarmer Outlet	1
	2113956	Screen	1
52	4142076	Duct	1
53	4142016	Elbow	1
54	4142069	Elbow	1
55	5142068	Split Tee	1
56	4202756	Duct	1

KEY TO FIGURE 543—Continued

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
57	4142151	Pilot's Footwarmer Outlet	1
	2113956	Screen	1
58	2142097	Duct	1
59	4142098	Duct	1
60	4142070	Elbow	1
61	1202856	Duct	1
62	5116435	Servo Unit	1
63	4142083	Elbow	1
64	2142259-10	Duct	1
65	5143454	Control Assembly to Pilot's Compartment	1
66		Windshield Stowage Container	1
67	4142084	Duct	1
68	2141689	Radio Operator's Flexible Hose	1
69	2142448	Adapter	1
70	4202612	Duct	1
71	4202611	Duct	1
72		Radio Operator's Flexible Hose Handwarmer Control	1
73	5143573	Control Box	1
74	5141983-1	Mixing Chamber RH	1
75	2202440	Elbow	1
76	4141970	Reducer	1
77	2141689	Navigator's Flexible Hose Handwarmer Control	1
78	4141970	Reducer	1
79	4202423	Elbow	1
80	4141675	Outlet to Navigator's Flexible Hose Handwarmer	1
81	5141983	Mixing Chamber LH	1
82	2142845	Elbow	1
83	4142360	Air-Intake Scoop to Muff-Type Heat Exchanger	1
84	4141981	Connection	1
85	4142837-2	Control Assembly to LH Mixing Chamber	1
86	2141757	Elbow	1
87	2141754	Duct	1
88	4141766	Duct	1
89	4141806	Elbow	1
90	4141733	Duct	1
91	5142840-4	LH Emergency Spill Valve Control Assembly	1
92	Fenwal, Type 732-1F	Critical Temperature Thermoswitch	2
93	5171474	Muff-Type Heat Exchanger LH	1
94	2142448	Adapter	1
95	4142295	Tube	1
96	4142467	Duct	1

has been removed and the right-hand mixing chamber valve control has been moved to a location behind the copilot's seat. The right-hand engine muff-type heat exchanger (9, figure 543) supplies heat to the right-hand mixing chamber where it is mixed with cool air as is necessary to regulate the temperature. This air flows into the pilots' and radio operator's compartment through the following outlets: pilot's foot warmer outlets (51 and 57, figure 543), radio operator's heat outlet (23, figure 543), radio operator's flexible hose hand warmer (68, figure 543). The left-hand engine muff-type heat exchanger operates similarly, in conjunction with the left-hand mixing chamber to supply warm air to the main cargo duct, the defroster unit, and the navigator's compartment. The following outlets are utilized: astrodome defroster outlet (14, figure 543), windshield defrosting outlets (1, figure 543), pilot's hand warmer outlets (51 and 7, figure 543), navigator's outlet (43, figure 543), navigator's flexible hose hand warmer (77, figure 543), and outlets located in the main cargo compartment duct (35, figure 543). Controls, with the exception of those adjacent to, and integral with, the outlet valve which they control, have a flexible push-pull linkage which extends from the control to the applicable outlet valve (figure 543). When the defrosting outlets con-

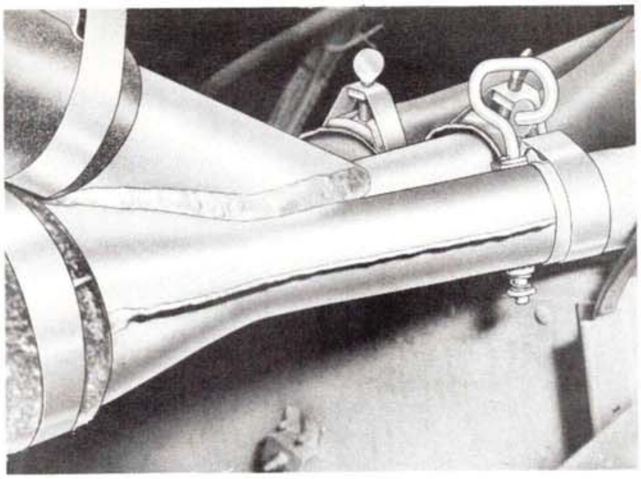


Figure 544—Five-Way Branch Duct, Hot Air System (On Some Airplanes)

trol (figure 545) is turned to the "EMERGENCY DEFROST BLOWER ON" position, it automatically flips a spring-loaded switch which starts the electric motor of the emergency defrosting blower. When the control is moved from this position, the switch returns to its former position, thus breaking the electric blower motor circuit. Other information pertaining to this hot-air type system is similar to that describing the other hot-air type system. (Refer to paragraph 18.*c.*, this section.)

(2) MUFF-TYPE HEAT EXCHANGER.
(See 9 and 93, figures 543 and 528.)

Note

Muff-type heat exchangers on both hot-air type systems are identical. (Refer to paragraph 18.*c.*(2), this section.)

(3) MIXING VALVE ASSEMBLY
(mixing chamber).

Note

Mixing chambers on both systems are identical. (Refer to paragraph 18.*c.*(3), this section.)

(4) DUCTS, FLEXIBLE HOSE, OUTLETS.

Note

Information pertaining to ducts, flexible hose, and outlets, for both systems is similar. Refer to paragraph 18.*c.*(4), this section. Arrangement is, however, necessarily different (see figures 527 and 543).

(5) CONTROLS AND VALVES.
(See figures 543 and 546.)

(a) DESCRIPTION.—There are two types of controls used: those controls (33, 65, 85 and 91, figure 543), which consist of a flexible push-pull linkage between the control plunger and the applicable valve, and those controls in which the control is adjacent to, and integral with, the applicable outlet valves. Controls of the first type attach to the right-hand spill valve (19, figure 543), the left-hand mixing chamber (81, figure 543) and the right-hand mixing chamber (74, figure 543). The first three control plungers are installed in a box which is located in the radio operator's compartment; the fourth is installed behind the copilot's seat. The controls attached to the mixing chambers directly affect the temperature of the air within the fuselage compartments—the other controls are for the purpose of regulating the flow of air through the outlets.

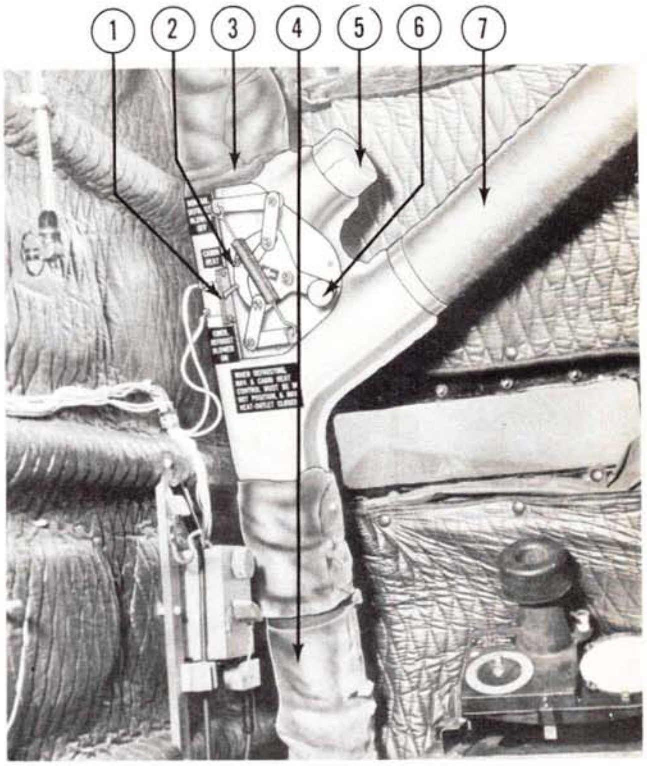


Figure 545—Navigator's Compartment Hot Air System (On Some Airplanes)

1. Electric Defroster Blower Motor Switch
2. Stop
3. Duct to Main Cabin Duct
4. Duct to Warm Air Outlet
5. Duct to Electric Defroster Blower. (Plug Inserted on Some Airplanes)
6. Outlet Control
7. Hose to Windshield Outlets

Note: Refer also to figure 543.

(b) REMOVAL.—Similar to the procedure described in paragraph 18.*c.*(5)*(b)*, this section.

(c) MAINTENANCE REPAIR OR REPLACEMENT.—Controls should be replaced rather than be repaired.

(d) ASSEMBLY AND INSTALLATION.—Reverse the removal procedure.

(e) TEST AFTER INSTALLATION. — Check all controls for freedom of movement, correct attachment, and throw.

(6) THERMOSWITCHES AND WARNING LAMPS.

Note

Information pertaining to thermoswitches and warning lamps is identical for both systems. (Refer to paragraphs 14.*k.*(12)*(g),* and 18.*c.* (6), this section.)

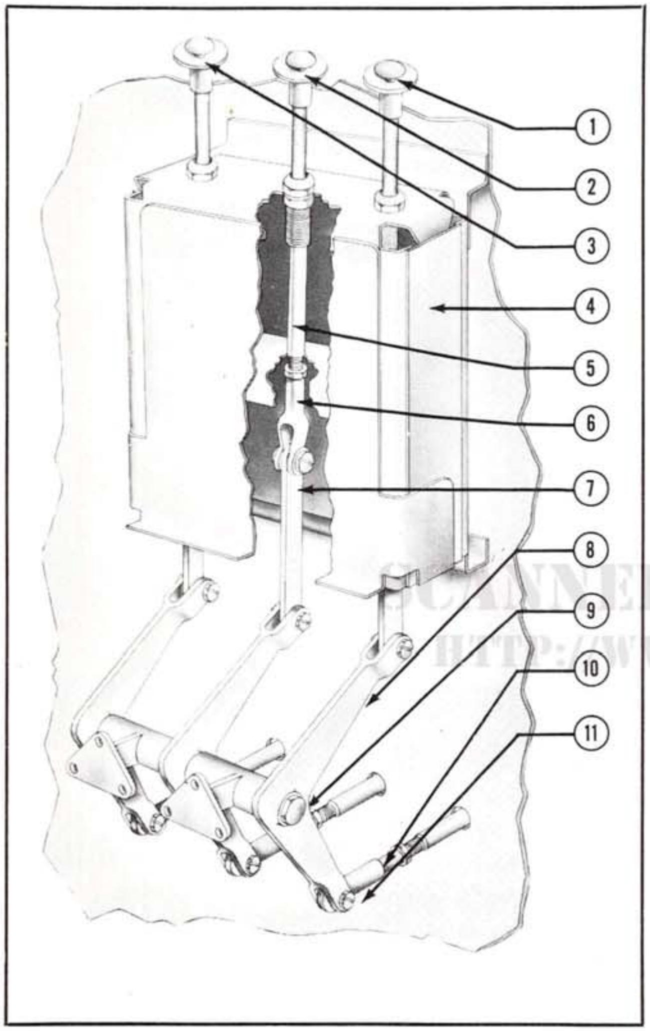


Figure 546—Control Box, Three Button Plunger

(7) WINDSHIELD DEFROSTING SHIELDS.—(Refer to paragraph 18.*b.*(11), this section.)

(8) ELECTRIC EMERGENCY DEFROSTING BLOWER. *(See 16, figure 543.)*

(a) DESCRIPTION.—An electric emergency defrosting blower is installed in the windshield defrosting system (on some airplanes) for the purpose of providing defrosting on the ground and for emergency conditions. When the defrosting valve control is placed in the "EMERGENCY DEFROST BLOWER ON" position, it automatically actuates a spring-loaded switch which starts the emergency blower motor. The switch returns to its original position (thus de-energizing the electric motor) when the defrosting valve control is moved from the "EMERGENCY DEFROST BLOWER ON" position.

(b) REMOVAL AND DISASSEMBLY.

1. REMOVAL.

a. Disconnect electric motor plug.

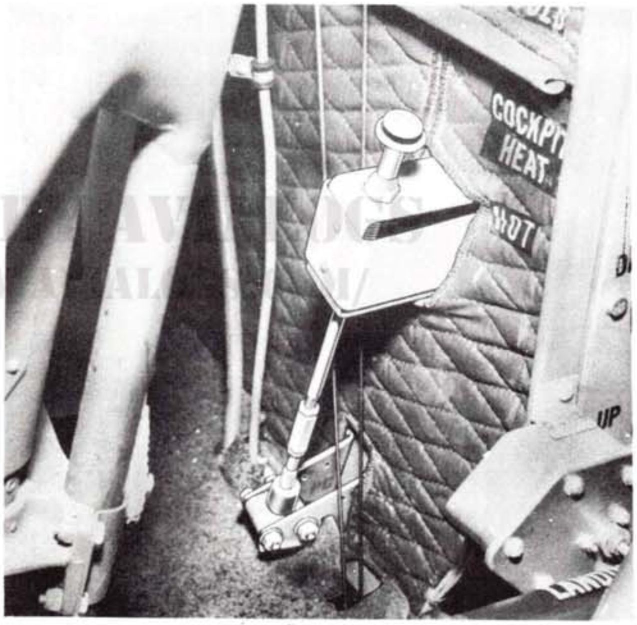


Figure 547—Pilot's Hot Air Control (Installed on Some Airplanes)

KEY TO FIGURE 546

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1		LH Mixing Chamber Control	1
2		LH Emergency Spill Valve	1
3		RH Emergency Spill Valve	1
4	5143573	Box Assembly	1
5	2142354	Lever Assembly	3
6	AN486-4	Clevis	3
	AN316-4r	Nut	3
	AN23-18	Bolt	3
	AN320-3	Nut	3
7	1142096	Link Assembly	3

Note: Refer also to figure 543.

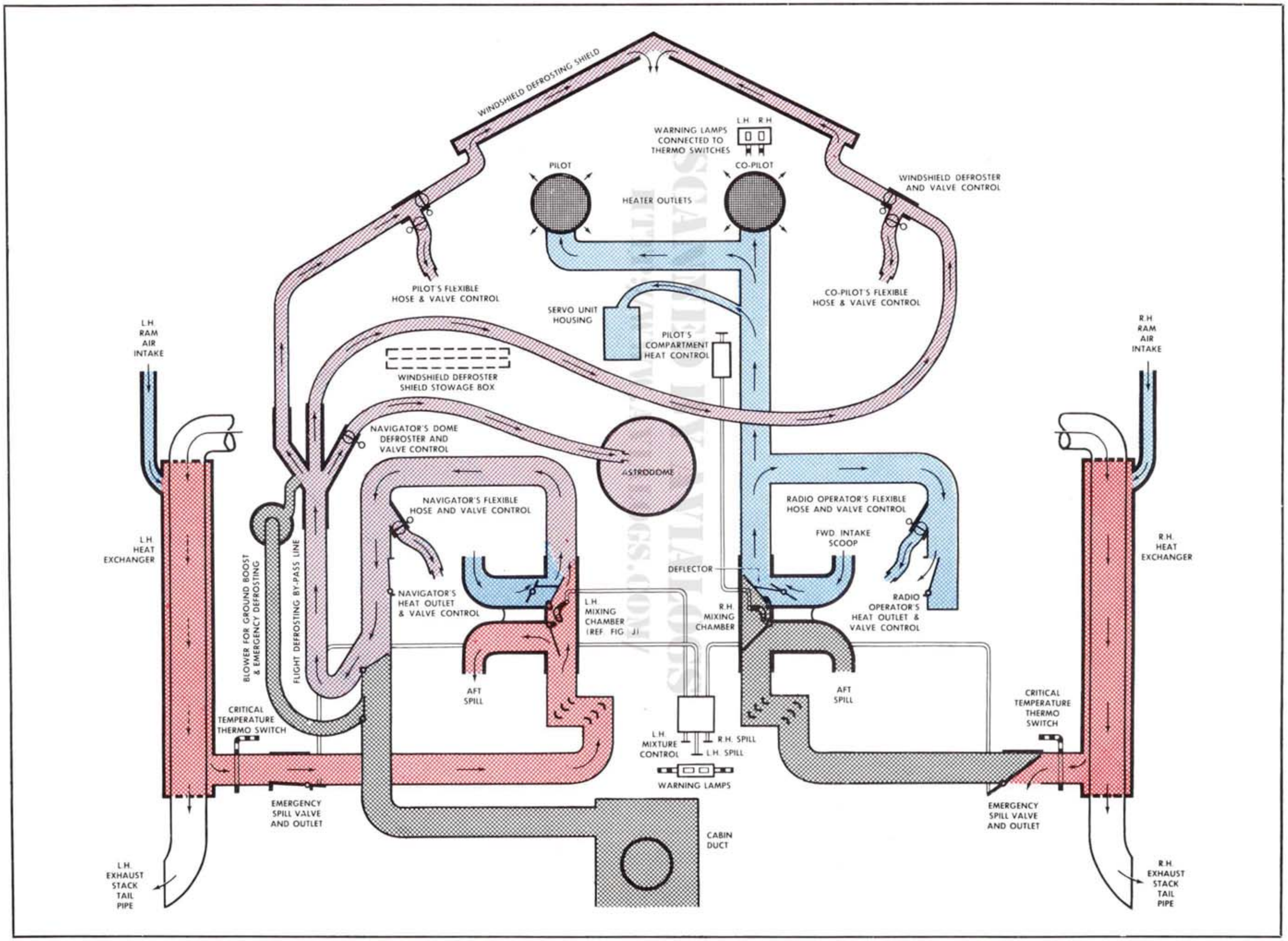

WINDSHIELD DEFROSTING SHIELD
WARNING LAMPS CONNECTED TO THERMO SWITCHES
L.H. R.H.
PILOT
CO-PILOT
HEATER OUTLETS
WINDSHIELD DEFROSTER AND VALVE CONTROL
PILOT'S FLEXIBLE HOSE & VALVE CONTROL
CO-PILOT'S FLEXIBLE HOSE & VALVE CONTROL
SERVO UNIT HOUSING
PILOT'S COMPARTMENT HEAT CONTROL
L.H. RAM AIR INTAKE
R.H. RAM AIR INTAKE
WINDSHIELD DEFROSTER SHIELD STOWAGE BOX
NAVIGATOR'S DOME DEFROSTER AND VALVE CONTROL
ASTRODOME
NAVIGATOR'S FLEXIBLE HOSE AND VALVE CONTROL
RADIO OPERATOR'S FLEXIBLE HOSE AND VALVE CONTROL
FWD. INTAKE SCOOP
L.H. HEAT EXCHANGER
R.H. HEAT EXCHANGER
DEFLECTOR
BLOWER FOR GROUND BOOST & EMERGENCY DEFROSTING
FLIGHT DEFROSTING BY-PASS LINE
NAVIGATOR'S HEAT OUTLET & VALVE CONTROL
L.H. MIXING CHAMBER (REF. FIG. J)
R.H. MIXING CHAMBER
RADIO OPERATOR'S HEAT OUTLET & VALVE CONTROL
AFT SPILL
AFT SPILL
CRITICAL TEMPERATURE THERMO SWITCH
CRITICAL TEMPERATURE THERMO SWITCH
L.H. MIXTURE CONTROL
R.H. SPILL
L.H. SPILL
WARNING LAMPS
EMERGENCY SPILL VALVE AND OUTLET
EMERGENCY SPILL VALVE AND OUTLET
CABIN DUCT
L.H. EXHAUST STACK TAIL PIPE
R.H. EXHAUST STACK TAIL PIPE

Figure 548—Hot Air System (As Installed on Some Airplanes)

SCANNED BY AVIALOGS HTTPS://WWW.AVIALOGS.COM/

b. Detach flexible hose.

c. Remove bolts attaching blower (through blower hose) to plywood shelf.

2. DISASSEMBLY.—The electric emergency defrosting blower should be disassembled only at a repair depot.

(c) MAINTENANCE REPAIR OR REPLACEMENT. – Damaged emergency defrosting blowers should be replaced rather than repaired. (Refer also to paragraph 14.*l*.(6), this section.)

(d) TEST BEFORE INSTALLATION.—It is advisable to test the electric motor before installing the emergency defrosting blower if electrical facilities are available.

(e) ASSEMBLY AND INSTALLATION.—Reverse of the removal and disassembly procedure.

(f) TEST AFTER INSTALLATION.—Place the defrosting valve control in the "EMERGENCY DEFROST BLOWER ON" position and check to see that blower accelerates velocity of air being emitted from windshield defrosting outlet.

(g) MAJOR OVERHAUL.—If a blower is damaged or fails to operate properly, it should be sent to a repair depot for overhaul.

(9) AUXILIARY HEATER. – Provisions are made, on some airplanes, for the installation of a Stewart-Warner gasoline engine-driven auxiliary heater. This heater is located approximately between stations 492 and 506. It is of value when the temperature is extremely low. The following parts are shipped from the factory:

Part No.	*Part Name*	*No. Required Per appliance*
2142299-2	Vent Line S-W Heater	1
2142165	Tube assembly	1
AN816-16	Nipple	1
4142266	Mount	1
AN4-11A	Bolt	4
AF945-4	Washer	4
AN315-62	Nut	3
S-1087510-616-28	Screw	3

e. HEATING AND VENTILATING TROUBLE SHOOTING.

(1) STEAM SYSTEM.

Trouble	*Probable Cause*	*Remedy*
STEAM SYSTEM WILL NOT OPERATE.	Steam shut-off steam valve will not open.	
	Valve is damaged.	Replace duct assembly.
	Control linkage is faulty.	Replace or repair linkage.
	Ducts are damaged or insecurely attached, thus permitting leakage of warm air.	Replace badly damaged ducts. Weld small holes. Correct attachment if necessary.
	Steam lines are damaged or insecurely attached, thus permitting leakage of steam.	Replace badly damaged lines. Weld small holes. Correct attachment if necessary.
	Water supply tank (or tanks) is damaged, thus permitting water to escape.	Replace badly damaged tanks. Weld small holes.
	Boiler is damaged, thus permitting water and steam to escape.	Replace.
	Radiator is damaged, thus permitting water and steam to escape.	Replace.
	Right-hand exhaust tail pipe is damaged, thus failing to heat water.	Replace.
	Steam system is frozen due to cold weather conditions.	Force warm air through ducts and lines. Use alcohol to thaw out lines.

HEATING AND VENTILATING TROUBLE SHOOTING SYSTEM—Continued

Trouble	*Probable Cause*	*Remedy*
STEAM SYSTEM OPERATES IMPROPERLY.	Maximum amount of heat is not produced.	
	Air eliminator or air eliminators, are faulty.	Replace air eliminator.
	Ducts, lines, or component parts are not attached securely or have small holes in them, thus permitting leakage.	Correct attachment. Repair small holes by welding.
	Controls are improperly operated.	In extremely cold weather the dial reading of the pressure gage may not register 25 psi. It may be found that if the intake valve is closed slightly that the temperature within the fuselage compartments will increase.
	Tank (or tanks), boiler or radiator, is faulty.	Replace, or if damage is small, repair by welding.
	Lines, or ducts, are clogged.	Force air through lines or ducts to remove obstruction.
	Regulator defective as evidenced by a too frequent opening of relief valve.	Replace regulator.
	Valves are improperly installed in relation to applicable control and control decalcomania.	Install properly.

(2) HOT AIR SYSTEMS.

Trouble	*Probable Cause*	*Remedy*
HOT AIR SYSTEMS OPERATE IMPROPERLY.	Component parts are faulty or damaged.	Replace. Component parts made of aluminum alloy may be repaired by welding if damage is not excessive. Hose and tubing may be wrapped with tape.
	Connections between ducts, or ducts and component parts are insecure.	Fix connection.
	Controls are incorrectly attached or are damaged.	Remedy attachment. Replace control or control part if damaged.
	Critical temperature warning lamps fail to light.	Check wiring. Check bulbs.
	Emergency defroster blower fails to operate.	Check wiring. Check duct connection.

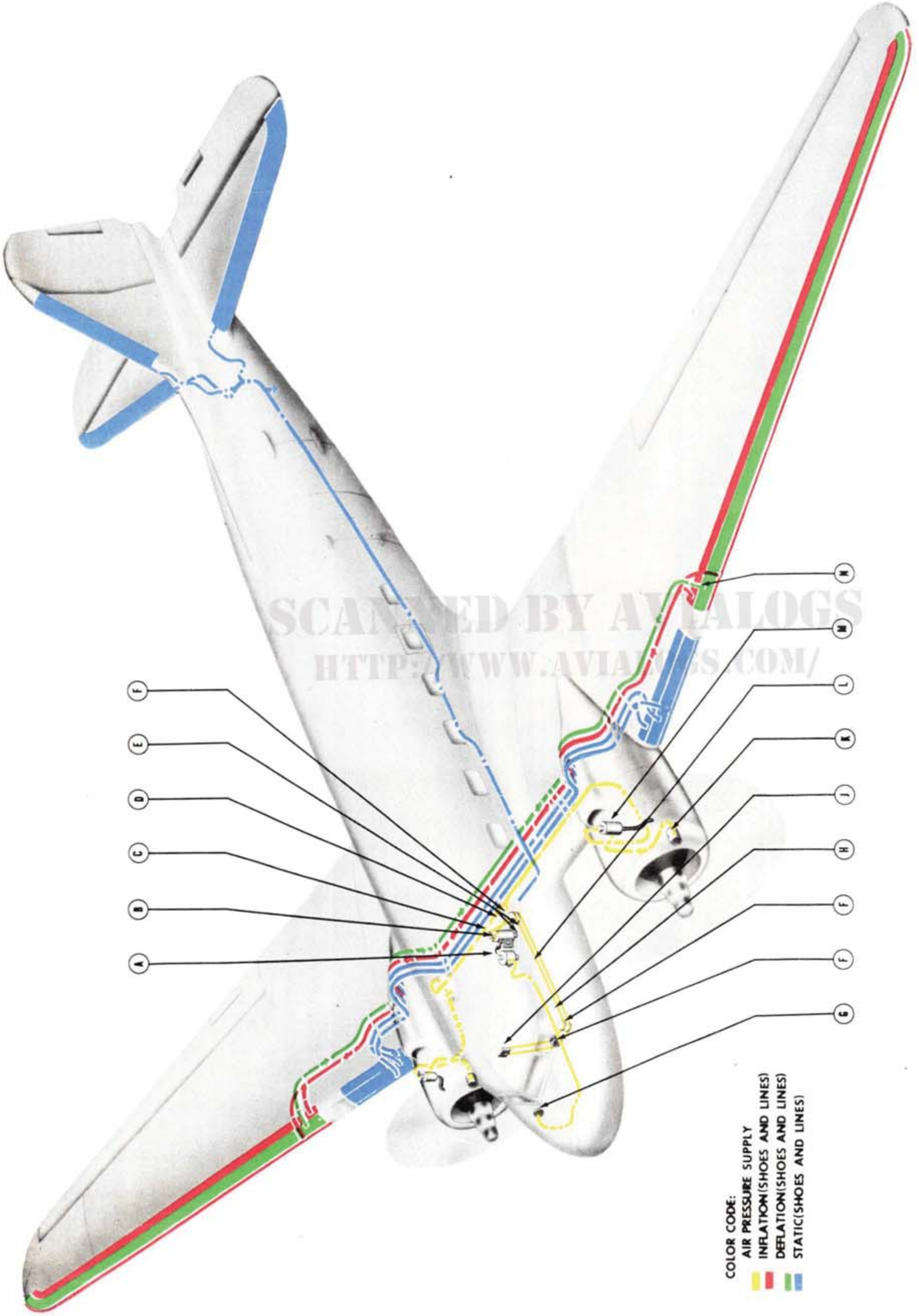

A
B
C
D
E
F
F
G
F
H
J
K
L
M
N
COLOR CODE:
🟨 AIR PRESSURE SUPPLY
🟥 INFLATION(SHOES AND LINES)
🟩 DEFLATION(SHOES AND LINES)
🟦 STATIC(SHOES AND LINES)

Figure 549—Surface De-Icer System

KEY TO FIGURE 549

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
A	559-1	Air Filter (Oil Separator)	1
B	572-2	Distributor Valve	1
C	2074406-6-5-2716	Aft Short Cable	1
D	2074406-6-5-2116	Forward Short Cable	1
E	1139505	Turnbuckles	2
F	AN210-1A	Pulley	3
G	225-F-01	Kollsman Gage	1
*H	2119151-1	Outboard Long Cable	1
J	4119348	Control Handle	1
K	207JA Type B-12	Vacuum Pump	2
*L	2119151-3	Inboard Long Cable	1
M	4116982	Oil Separator	2
N	Goodrich 2-364-3-1	De-Icer Shoe (LH Outboard)	1
	2-364-3-2	De-Icer Shoe (RH Outboard)	1
	2-364-2-1	De-Icer Shoe (LH Inboard)	1
	2-364-2-2	De-Icer Shoe (RH Inboard)	1
	2-364-4-1	De-Icer Shoe (Horizontal Stabilizer)	2
	2-364-5-1	De-Icer Shoe (Vertical Stabilizer)	1

*See cable chart—section IX.

19. ICE ELIMINATION SYSTEMS.

a. GENERAL.—There are two basic methods for eliminating ice. One method employs any mechanical contrivance to break up or scrape off ice after it has formed. This is commonly known as de-icing. The second method employs either heat or alcohol to prevent ice from forming. This is commonly known as anti-icing.

Note

Two conditions must exist for ice formation: moisture must be present in visible form, and the air or airplane temperature must be approximately 2°C (36°F) or less. There are three types of ice formation: clear ice, rime, and rime frost. Formation of rime frost on an airplane is caused by its coming in contact with moisture droplets supercooled below the normal freezing point. The surface tension of these droplets prevents them from expanding and freezing. When struck by an airplane, the surface tension of the droplet is disturbed and it becomes ice frozen to the airplane.

b. DE-ICING.—Though de-icing includes the operation of the windshield wipers (refer to paragraph 16.*d.*(15), this section), this paragraph includes only surface de-icing or the breaking up of ice on the airfoils.

Note

Deformation of an airfoil and, to a less extent, weight of ice will cause an airplane to get out of control. Enough clear ice to cause sluggish aircraft operation may form in as brief a time as 10 minutes. However, it is necessary for best results to wait until 1/8-inch of ice has formed before starting the de-icing process.

(1) SURFACE DE-ICER SYSTEM.
(See figure 549.)

(a) GENERAL.—Air from the exhaust (pressure ports) of the two-engine vacuum pumps (K, figure 549) flows through two oil separators (M, figure 549), two check valves (figure 554), an air filter (A, figure 549), and a distributor valve (B, figure 549), to alternately expand and contract de-icer shoes along the leading edges of the wings and the horizontal and vertical stabilizers. This swelling-depressing action cracks ice formations on the shoes, and the air stream blows them off. A control system incorporating a handle (J, figure 549) and cables, turns the motor of the distributor valve "ON" or "OFF" through a control unit. At the same time it closes or opens the overboard port in the unit. A pressure relief valve in the air filter regulates the pressure in the system. A gage (G, figure 549) on the instrument panel and connected by a line from the air filter indicates the air pressure in psi. On the vacuum side of the pump is a suction line for the operation of the gyro instruments. (Refer to paragraph 11.*d.,* this section.) The vacuum or suction line incorporates two valves: a vacuum-relief valve (figure 314) which controls the correct amount of suction necessary to operate the gyro instruments; and a check valve (figure 554) to prevent oil or dirt in the airflow from entering the gyro instruments in case of pump reversal due to backfire or kickback.

(b) VACUUM PUMPS.
(See figures 551 and 552.)

1. DESCRIPTION. — Each B-12-3P-207-J.A.

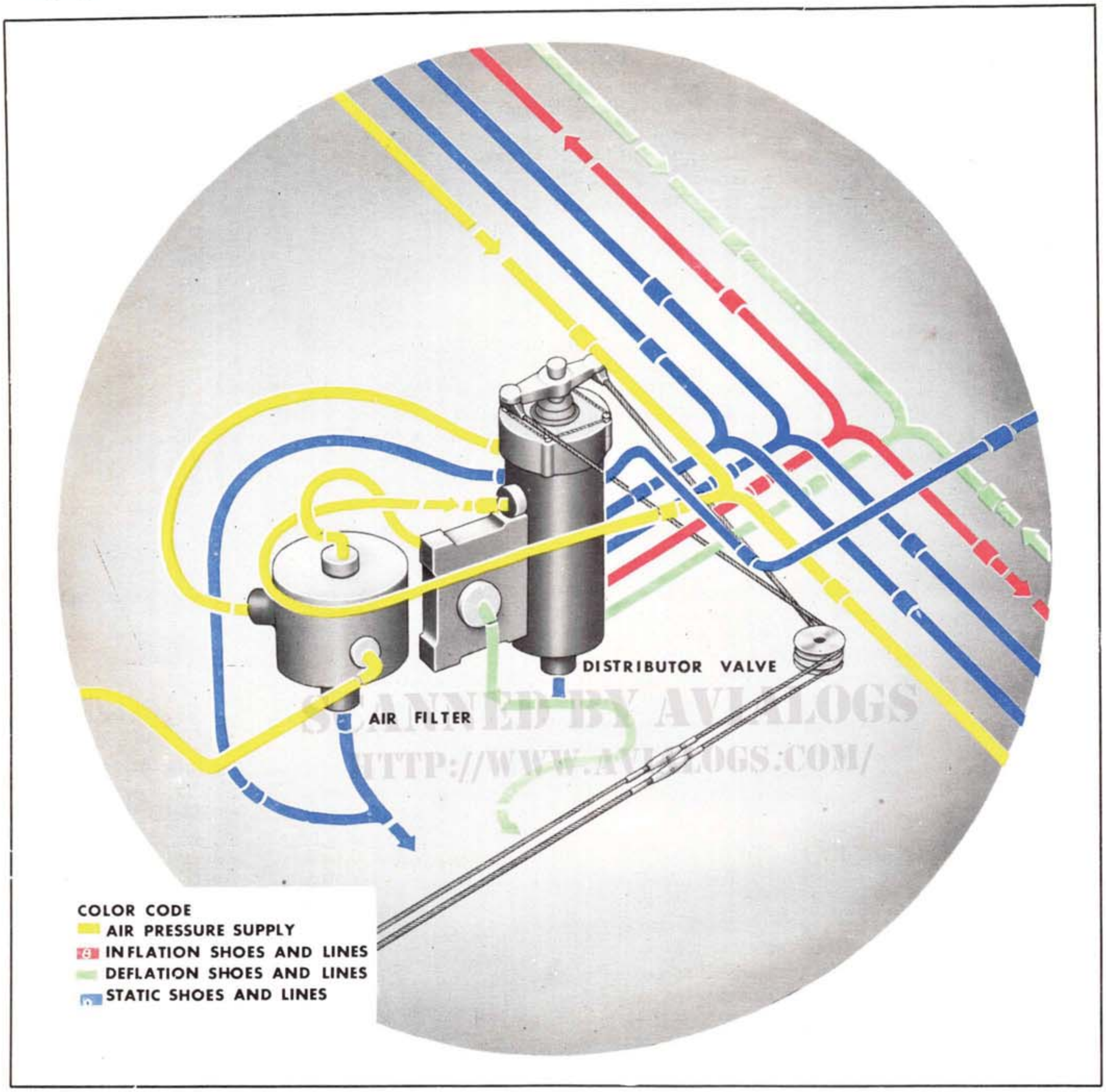


Figure 550—Distributor Valve and System Detail

Pesco pump, bolted to and driven by the engine, supplies vacuum (suction) from the inlet port for operation of the gyro instruments and pressure from the outlet port for operation of the de-icer system. Torque is transmitted from the engine drive gear to the pump rotor by a coupling. The bore of the sleeve is divided into four sections by the rotor and blades. Since the axis of the rotor is eccentric with that of the sleeve, the sections are of unequal volume, the smaller sections being next to the point where the rotor is closest to the wall of the sleeve. As the rotor turns, the four sections pass successively the point where the volume of each is at a minimum. From this point the volume of each section increases during one-half rotation, creating a suction and drawing in air from the nearest port. During the second half rotation the section volume decreases and the air is forced out through a second port. The rapid succession of intakes produces a steady suction. Both pumps run continuously with the engines and are directly lubricated by engine oil. It flows through a tiny aligned hole from the rear accessory drive section of the engine, through a gasket (4, figure 551) and the pump mounting flange to the working parts of the pump. The pump has four of these holes, any one of which may serve for lubrication. Consequently, when one is aligned from the engine, the other three are blocked off by the gasket. The oil functions as a seal for the compartment as well as a lubricant. It is discharged from the pressure port of the pump. The rated capacity is 9.8 cubic feet of air per minute at 2250 rpm with 4.5 inches Hg. inlet suction, 17.1 inches Hg. outlet pressure and 50 psi oil pressure. The pump has a displacement of 14.4 cubic inches per revolution. It will operate in either direction.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect pressure and suction lines.

(2) Remove four bolts attaching pump to engine.

(3) Pull pump away from engine.

b. DISASSEMBLY.

(1) Remove screws from cover and lift cover off.

(2) Remove blades, sleeve, and rotor.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Dress scuffed blades on a smooth, flat oilstone, but the original radius on the edges must be maintained.

b. Dress rotor slots with an oilstone.

c. Replace damaged oil-metering collar or metering pin.

d. If coupling shows signs of wear or has failed, remove the snap ring, extract coupling, and replace it.

e. Replace worn or damaged gasket.

f. Replace badly damaged or worn pump.

4. ASSEMBLY.—When mounting cover, rotate cover from side to side as metering pin engages the collar until the dowel pin in the body engages the locating hole in cover.

5. TEST BEFORE INSTALLATION.

a. Check all ports for clearances.

b. Remove plugs from ports before turning coupling.

c. Turn coupling by hand to insure freedom of operation.

d. Before installation of lines, place a paper over the discharge port and note that oil collects on paper to insure proper lubrication.

6. INSTALLATION.—Align any one of the four oilholes in pump with the one in engine mounting pad and flange gasket.

WARNING

Be sure the oilhole is aligned.

7. TEST AFTER INSTALLATION. — Start system with engines running and check operation of pump for temperature rise, oil flow and seal leakage.

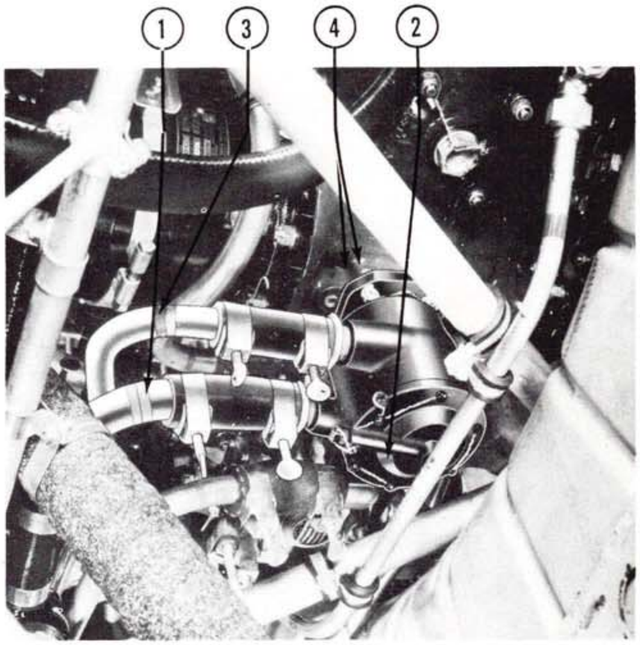


Figure 551—Vacuum Pump Installed

1. Vacuum Line
2. Cover Plate
3. Pressure Line
4. Mounting Pad and Gasket

8. MAJOR OVERHAUL.—This must be performed at depots only.

(c) OIL SEPARATORS. *(See figure 553.)*

1. DESCRIPTION.—An Eclipse oil separator, bracketed to the top of the engine mount, receives the air from the pressure port of the vacuum pump through the separator inlet port near the top on the side. Centrifugal force whirls the air, saturated with engine oil used in lubricating the pump, about the separator bowl. The oil (and some water due to sweating) collects on the bowl and drains through a restrictor at the bottom to the rear accessory drive section (case) of the engine. The air continues through a standpipe extending vertically from the outlet port at the top. The separator is a welded unit and cannot be disassembled.

2. REMOVAL.

a. Disconnect inlet and outlet lines.

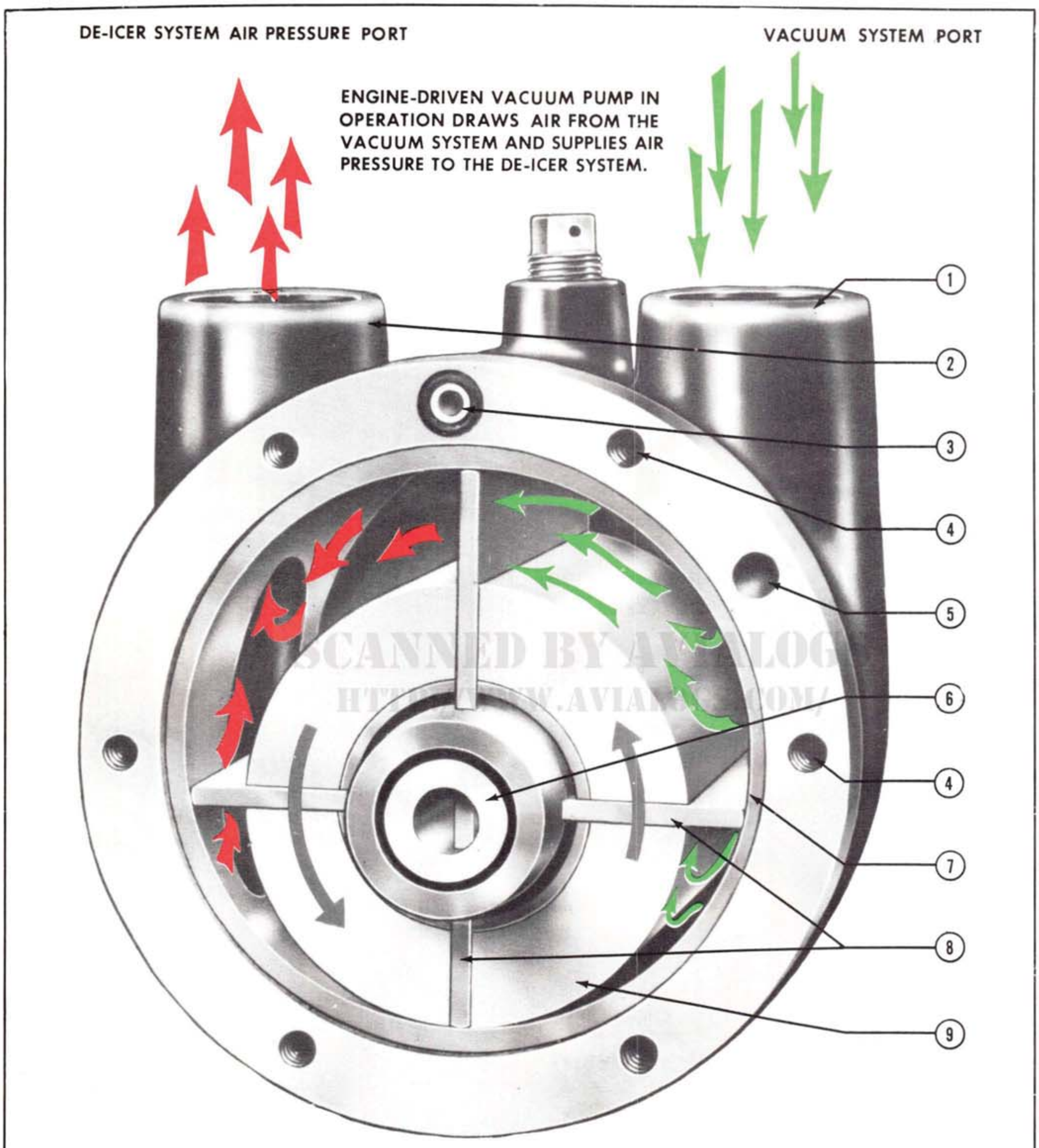
b. Disconnect line between bottom drain and engine rear section.

c. Remove attaching bracket and remove separator.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. If separator is clogged, dirty, or functions sluggishly, remove it. Clean it out thoroughly with a good solvent and blow it out with air.

b. Replace a worn or damaged separator.


DE-ICER SYSTEM AIR PRESSURE PORT
VACUUM SYSTEM PORT
1
2
3
4
5
6
4
7
8
9

ENGINE-DRIVEN VACUUM PUMP IN OPERATION DRAWS AIR FROM THE VACUUM SYSTEM AND SUPPLIES AIR PRESSURE TO THE DE-ICER SYSTEM.

OFF CENTER ROTOR REVOLVING ABOUT FIXED CENTER FORCES BLADES TO SHUFFLE IN AND OUT OF ROTOR AGAINST SIDE OF CHAMBER. CHAMBER AREAS INCREASE ON ONE SIDE CREATING A VACUUM AND DECREASE ON OTHER SIDE CREATING PRESSURE.

COLOR CODE: 🟩 VACUUM 🟥 AIR PRESSURE

Figure 552—Vacuum Pump (Cutaway View)

1. Inlet Port
2. Outlet Port
3. Bearing Lubrication Channel
4. Cover Attaching Holes
5. Cover Hole Pin
6. Shaft
7. Sleeve
8. Blades
9. Rotor

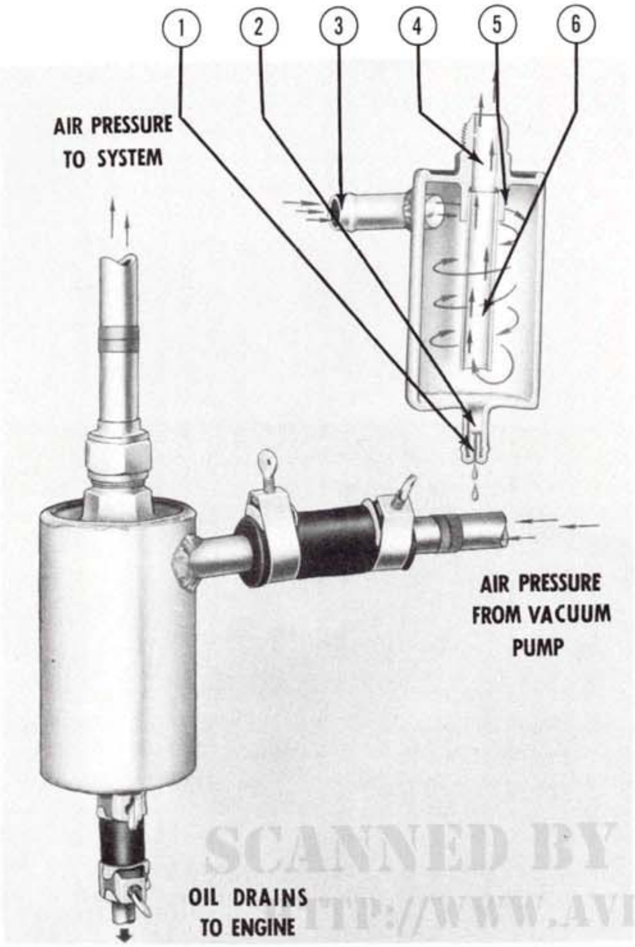


Figure 553—Oil Separator and Oil Separator (Cutaway View)

1. Restrictor
2. Oil Drain
3. Inlet Port
4. Outlet Port
5. Separator Bowl
6. Standpipe

4. TEST BEFORE INSTALLATION.—Plug outlet port and apply pressure (20 psi) to inlet port. Place the separator in water and test for leakage. Bubbles will appear if and where the unit is leaking.

5. INSTALLATION. – Install in a vertical position, checking connections for security.

6. TEST AFTER INSTALLATION. – With system operating, check for leakage and performance.

(d) CHECK VALVES (PRESSURE LINE).

1. DESCRIPTION.—A safety valve is installed in each line aft of the oil separator. (See figure 554.) One is on the inboard forward side of the right nacelle; the other, on the inboard aft side of the left nacelle.

Note

This check valve is identical in construction with the check valve in the vacuum line. However, the direction of flow is reversed.

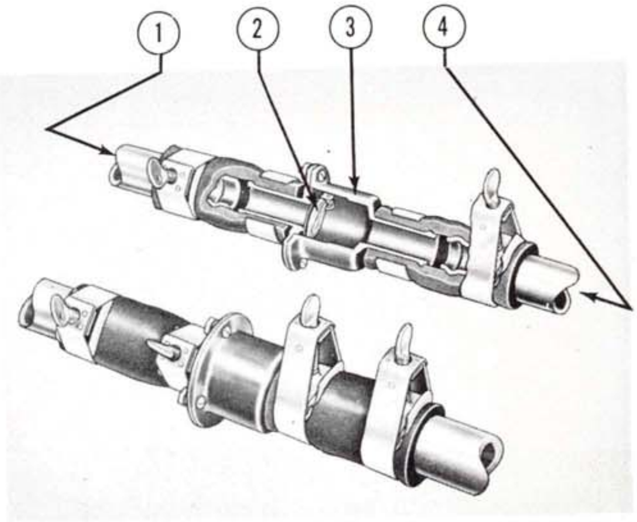


Figure 554—Surface De-Icer System Check Valve and Valve (Cutaway View)

1. Inlet Port
2. Disc and Spring
3. Barrel
4. Outlet Port

The air flows through the inlet port (an extended line fitting), unseats the spring-loaded disc, and continues through the outlet port to the distributor valve. By closing when the discharge pressure is less than the back pressure, the valve serves to maintain a constant pressure in the system, allowing it to operate in case of a pump or line failure.

Note

This is true because the system pressure output is determined by the pump putting out the more pressure.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Remove connecting hose from both valve ports.

(2) Plug both lines.

b. DISASSEMBLY.

(1) Remove attaching screws from mount or head.

(2) Separate units.

3. MAINTENANCE OR REPLACEMENT.

a. Replace damaged or twisted disc or washer.

b. Replace spring that cannot be properly adjusted.

Note

The spring tension on the disc is so little that one may barely blow through the valve to unseat the disc.

c. Replace leaking valve.

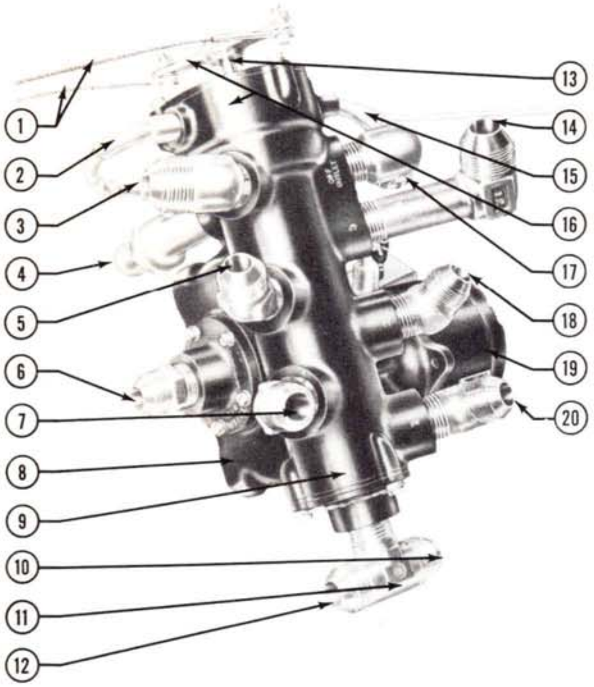


Figure 555—Surface De-Icer System Distributor Valve

1. Control Cables
2. Electrical Conduit
3. Port to Filter (Oil Separator)
4. Port to Main Pressure Line
5. Port 4, to Upper and Lower Tubes (Inboard Shoes)
6. "ON" Exhaust Port
7. Port 2 to Upper and Lower Tubes (Outboard Shoes)
8. Valve Housing Extension
9. Core Housing
10. Channel Drain and "ON" Exhaust Outlet
11. Tee
12. Tee Connection to "ON" Exhaust Port Line
13. Arm (Shaft and Core Connector)
14. Port 5 to Empennage Shoes
15. Electrical Conduit
16. Control Arm and Control Unit Housing
17. "OFF" Outlet (overboard) Port
18. Port 3 to Center Tubes (Inboard Shoes)
19. Motor Housing
20. Port 1 to Center Tubes (Outboard Shoes)

4. ASSEMBLY AND INSTALLATION.—Reverse removal and disassembly procedure.

WARNING

Be sure valve side marked "UP" is up and arrow points in direction of flow.

(e) DISTRIBUTOR VALVE. *(See figure 555.)*

1. DESCRIPTION.—The Eclipse (type 571) valve is bolted to the rear of the auxiliary wing spar on the right side of the center wing section. The body of the valve is a control unit consisting of a control arm which turns a shaft and heavy cylindrical core within a core housing. The housing incorporates electrical connections at the top, ports on either side, and a drain at the bottom. In front of the core housing are the extension housing, which houses the air passageways from the rotor distributor to the core, and the rotor distributor. To the right of the extension housing are the reduction gearing and motor housing. To the left of the extension housing is the "ON" exhaust port.

Note

The motor may be removed and attached to the "ON" exhaust port opening. In this case, the former motor attaching point becomes the "ON" exhaust port. This has been done, as shown in figures 556 and 557. To do this the distributor must be reversed. As there is no particular advantage in this change, it is inadvisable to make it.

When the control handle behind the copilot is turned to "ON" (figure 559), the arm (13, figure 555) at the top of the control unit turns and establishes an electrical contact to start the motor. (Refer to paragraph 14.*i.*(3), this section.) As the arm turns, it also turns the core, aligning five holes (figure 556) through the core to the five passageways through the extension housing, and to the five de-icer outlet ports in the core housing. At the same time, the core opens the port to the air filter on the upper left side of the control unit, and closes the "OFF" overboard port on the upper right side of the control unit.

Note

The core does not rotate 360 degrees as does the rotor. It has only two stationary positions: "ON" and "OFF."

The air from the pressure line enters the control unit at the upper front side. It flows through the outlet port to the filter, through the filter, and reenters the distributor valve in the gearing section of the motor. It continues to the rotor distributor which is making one complete rotation in every 40 seconds.

Note

The slow rotation of the rotor and distributor results from double reduction gearing. The rotor and distributor rotate only once to every 1120 turns of the motor shaft.

The inlet port of each passageway from the distributor to the core is at an equal distance from each other inlet port about the circumference of the distributor. Therefore, the distributor discharges air into each passageway for an equal period of time, namely 8 seconds, completing its rotation and the cycle of the five passageways in 40 seconds. The air continues through the passageway, through the hole in the core, and through an outlet port in the core housing in the following order:

a. No. 1 port (at lower right of core housing) to center tubes in right and left outboard de-icer shoes.

b. No. 2 port (at lower left of housing) to upper and lower tubes in right and left outboard shoes.

c. No. 3 port (at center right of housing) to center tubes in right and left inboard shoes.

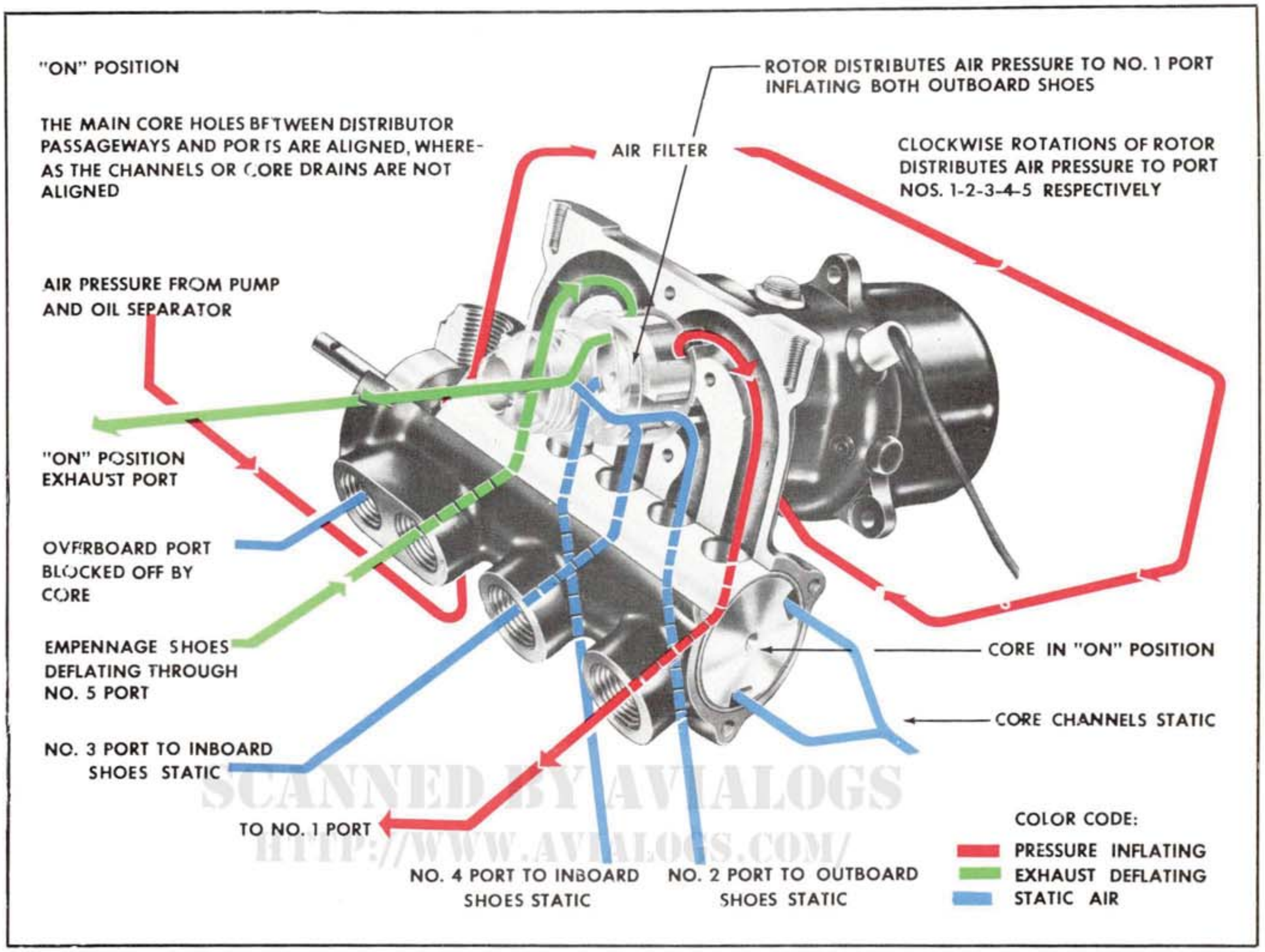

"ON" POSITION
THE MAIN CORE HOLES BETWEEN DISTRIBUTOR PASSAGEWAYS AND PORTS ARE ALIGNED, WHEREAS THE CHANNELS OR CORE DRAINS ARE NOT ALIGNED
AIR PRESSURE FROM PUMP AND OIL SEPARATOR
"ON" POSITION EXHAUST PORT
OVERBOARD PORT BLOCKED OFF BY CORE
EMPENNAGE SHOES DEFLATING THROUGH NO. 5 PORT
NO. 3 PORT TO INBOARD SHOES STATIC
TO NO. 1 PORT
NO. 4 PORT TO INBOARD SHOES STATIC
NO. 2 PORT TO OUTBOARD SHOES STATIC
AIR FILTER
ROTOR DISTRIBUTES AIR PRESSURE TO NO. 1 PORT INFLATING BOTH OUTBOARD SHOES
CLOCKWISE ROTATIONS OF ROTOR DISTRIBUTES AIR PRESSURE TO PORT NOS. 1-2-3-4-5 RESPECTIVELY
CORE IN "ON" POSITION
CORE CHANNELS STATIC
COLOR CODE:
🟥 PRESSURE INFLATING
🟩 EXHAUST DEFLATING
🟦 STATIC AIR

Figure 556—Surface De-Icer Control Unit ("ON" Flow)

d. No. 4 port (at center left of housing) to upper and lower tubes in right and left inboard shoes.

e. No. 5 port (at upper right of core housing) to both tubes in each of the three stabilizers.

Note

Both tubes in each stabilizer inflate simultaneously, as they are an integral unit. A web divides them.

After the tubes have inflated, the air pressure is cut off by the rotating distributor and the tubes deflate, returning the air through the same lines to the valve. It is discharged from the "ON" exhaust port at the center left of the extension housing. It continues through a tee screwed into the base of the control unit (core housing) and connecting the "ON" exhaust port line with the "OFF" core drain. The air flows overboard through a line from the tee projecting from the bottom of the wing. When the control handle is turned to "OFF," the motor stops, and at the same time the core (figure 557) turns to the "OFF" position. In this position the core blocks off the port to the air filter and opens the "OFF" overboard port. The air entering the control unit bypasses the port to the filter and is discharged through the "OFF" overboard or exhaust port. The line from this port joins the air filter drain or relief line in a "Y" beneath the filter. The air is expelled through this line which projects from the bottom of the wing a few inches in front of the "ON" exhaust line projection, or projection from the bottom of the distributor valve. In the "OFF" position the core also aligns rectangular channels (grooves at bottom of core visible in figure 556) to the de-icer shoe ports. The channels extend lengthwise along the surface of the core.

Note

The channels are covered by the core shell. The holes in the shell aligning the de-icer ports to the channels are not visible in the figure.

One channel aligns the 1-3-5 ports; and the other, the 2-4 ports. The air from the inflated shoes is returned through the ports to the channels and expelled from the channels through the bottom tee drain.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect five de-icer shoe outlet lines.

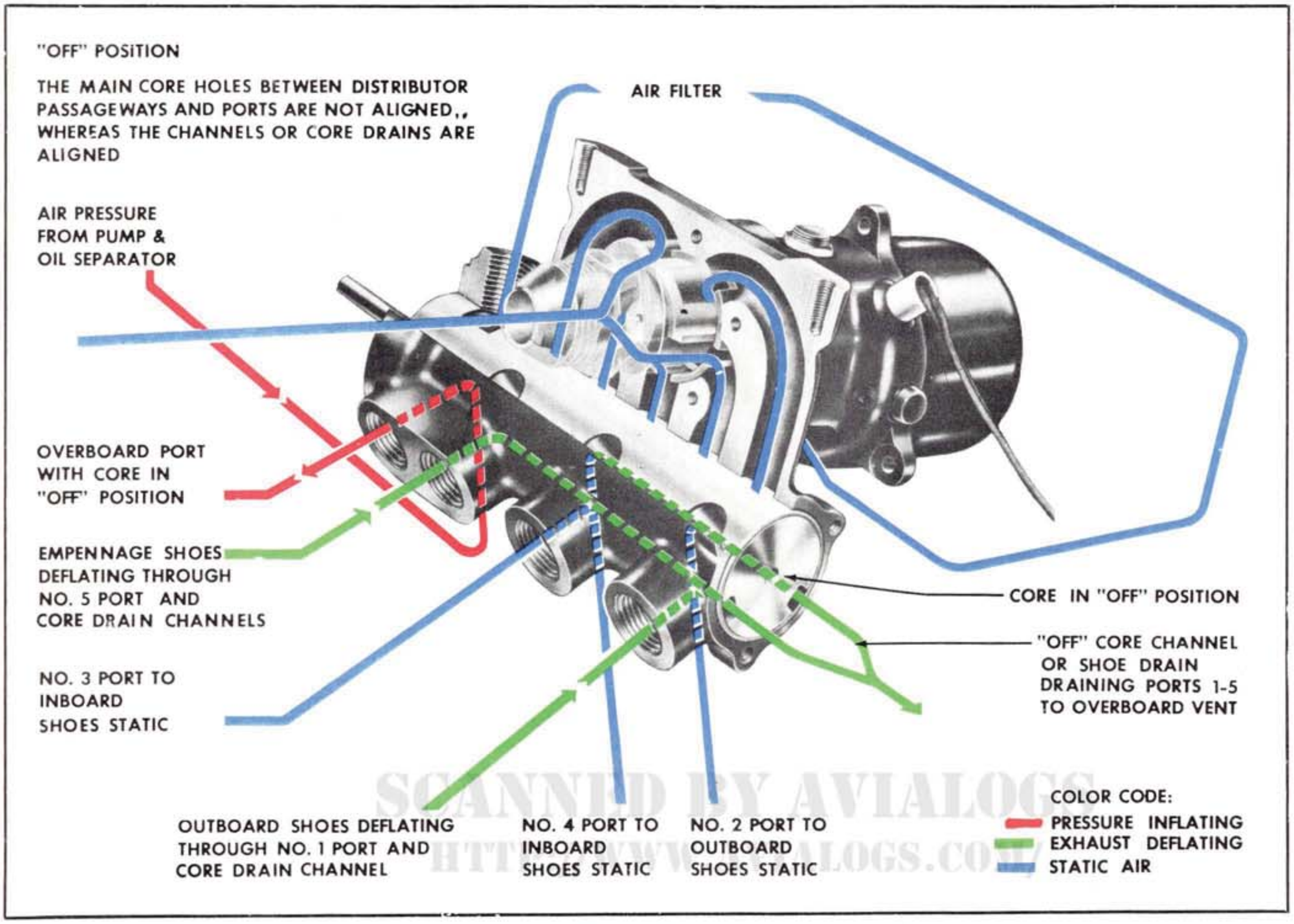

"OFF" POSITION
THE MAIN CORE HOLES BETWEEN DISTRIBUTOR PASSAGEWAYS AND PORTS ARE NOT ALIGNED,, WHEREAS THE CHANNELS OR CORE DRAINS ARE ALIGNED
AIR FILTER
AIR PRESSURE FROM PUMP & OIL SEPARATOR
OVERBOARD PORT WITH CORE IN "OFF" POSITION
EMPENNAGE SHOES DEFLATING THROUGH NO. 5 PORT AND CORE DRAIN CHANNELS
NO. 3 PORT TO INBOARD SHOES STATIC
CORE IN "OFF" POSITION
"OFF" CORE CHANNEL OR SHOE DRAIN DRAINING PORTS 1-5 TO OVERBOARD VENT
OUTBOARD SHOES DEFLATING THROUGH NO. 1 PORT AND CORE DRAIN CHANNEL
NO. 4 PORT TO INBOARD SHOES STATIC
NO. 2 PORT TO OUTBOARD SHOES STATIC
COLOR CODE:
🟥 PRESSURE INFLATING
🟩 EXHAUST DEFLATING
🟦 STATIC AIR

Figure 557—Surface De-Icer Control Unit ("OFF" Flow)

(2) Disconnect inlet line from pump.

(3) Disconnect outlet line to the air filter.

(4) Disconnect inlet line from air filter.

(5) Disconnect "OFF" overboard line from top.

(6) Disconnect "OFF" drain line from "ON" exhaust line from tee at bottom.

(7) Disconnect electrical wire to motor.

(8) Remove two bolts securing valve to spar.

(9) Disconnect cables from arm.

b. DISASSEMBLY.

(1) Unscrew five screws on motor to separate motor from valve.

(2) Remove screws at top and bottom of control unit.

WARNING

Complete disassembly of units must be performed at depots only.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Replace motor brushes less than 13/32 inch in length.

b. Replace any damaged or defective distributor valve units.

c. Make minor repairs as on any electric motor. Major repairs must be performed at depots only.

d. Replace defective distributor valve.

4. ADJUSTMENTS.—Adjust reduction gearing tension by two screws on the sides of the motor.

5. TEST BEFORE INSTALLATION. — Attach electrical lines and note rotor rotation and general performance.

6. ASSEMBLY AND INSTALLATION. — Reverse removal and disassembly procedure.

7. TEST AFTER INSTALLATION.—Turn system on and note if de-icer shoes are inflating properly. If not, test valve for leakage.

8. MAJOR OVERHAUL. — Must be performed at depots only.

(f) AIR FILTER. *(See figure 558.)*

1. DESCRIPTION.—The Eclipse air filter is

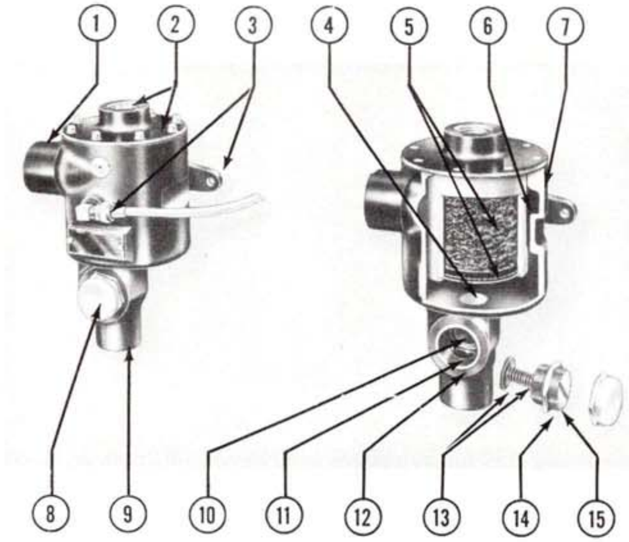


Figure 558—Air Filter (Oil Separator) and Filter (Cutaway View)

1. Inlet Port
2. Outlet Port and Separator Cover Plate
3. Mounting Flange and Gage Line Connection
4. Bowl Drain and Vent
5. Screen and Filament
6. Cartridge
7. Bowl
8. Cap
9. Vent Throat
10. Vent (Valve Seat)
11. Vent (In Valve Housing)
12. Valve Housing
13. Disc, Shaft, and Spring
14. Lock Nut
15. Regulator Screw

bolted to the front of the auxiliary wing spar, directly in front of the distributor valve.

Note

> The filter is in reality an oil separator. Air from the distributor valve control unit enters the side inlet port of the filter. Centrifugal force whirls the air about the filter bowl, separating the oil from the air, and leaving the oil deposited on the sides of the bowl. The air then flows through a screen at the bottom of a cartridge containing a copper and wool filament. It continues through the cartridge, through a similar screen at the top, and out the outlet port at the top of the filter. The oil drains from the bowl through a vent (4, figure 558) at the bottom of the bowl. It continues through a second vent seating the pressure relief valve and a third vent housing the valve, and drains through the vent throat. On the center face of the filter is a connection for the line to the gage.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect air inlet and outlet lines.

(2) Disconnect gage line.

(3) Disconnect vent or drain line.

(4) Disconnect two bolts attaching filter to spar.

b. DISASSEMBLY.

(1) Remove screws from cover.

(2) Lift off cover.

(3) Remove cartridge.

(4) Remove screens.

(5) Remove pressure relief valve. (Unscrew regulator screw.)

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Clean screens and bowl with gasoline.

b. Blow out screens and bowl with compressed air.

c. Replace defective screens.

d. Replace defective cartridge.

e. Replace damaged or worn filter.

4. ASSEMBLY AND INSTALLATION.—Reverse removal and disassembly procedure.

5. TEST AFTER INSTALLATION.—With pressure in the system, check connections for leaks.

(g) PRESSURE RELIEF VALVE.
(See 13, 14 and 15, figure 558.)

1. DESCRIPTION.—This valve regulates the pressure in the system. Correct setting is 8 psi. Within the valve housing beneath the filter bowl, the heavy disc-type valve is seated over a vent (10, figure 558) parallel with the axis of the filter and vent (9, figure 558) throat. Beneath and at right angles to the vent is another vent (11, figure 558). When the disc is tight against the upper vent it shuts off the lower one, eliminating the escape of air. As the disc withdraws from the upper vent, it opens the lower vent to the upper one, allowing air to escape through the lower one. The valve consists of a disc with an extended guide shaft, and an adjustable regulator screw, screwing in and out of the valve housing. A spring encircles the extended guide shaft and extends from the disc to the screw. In the regulator screw is a slot for the insertion of a screw driver to turn the screw to set the spring at the desired tension. The more air pressure applied to the disc, the more the spring depresses, allowing the disc to back up against the regulator screw and open up a larger section of the lower vent for air to escape. Screwing over the regulator screw is a lock nut to set and hold the regulator screw at a given position for a constant air pressure. When the regulator screw is turned clockwise, the tension on the disc increases, requiring a higher pressure to unseat it. When it is turned counterclockwise, the tension decreases and the valve opens at a lower pressure, resulting in the operation of the system at a lower pressure. A cap to keep out dust screws on the regulator screw against the lock nut.

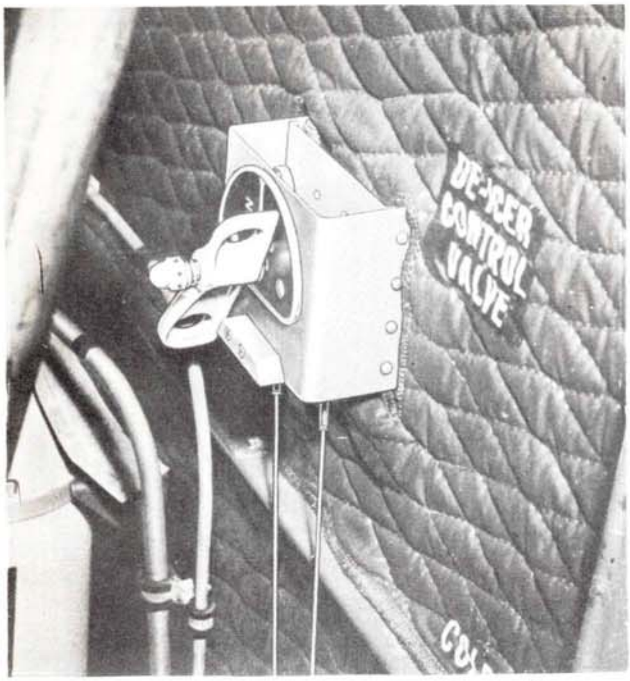


Figure 559—De-Icer Control Handle Installed

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Unscrew cap from regulator screw.

(2) Insert a screw driver in regulator screw slot and turn counterclockwise.

b. DISASSEMBLY.

(1) Remove lock nut.

(2) Separate units, disc and shaft, regulator screw and spring.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Resurface rough disc with an oilstone.

b. Replace any parts with torn threads.

c. Replace damaged spring or disc.

4. ADJUSTMENTS. — Turn regulator screw until gage records 8 pounds.

5. TEST BEFORE INSTALLATION.—With pressure in the system, adjust valve at various tensions to determine operation.

6. ASSEMBLY AND INSTALLATION. — Reverse removal and disassembly procedure.

7. TEST AFTER INSTALLATION. — With system operating, check valve for leaks and operation.

(b) PRESSURE GAGE. *(See figure 309.)*

1. DESCRIPTION.—The Kollsman, bourdon type (direct indicating) gage is mounted on the instrument panel directly in front of the copilot. It registers from 0 to 20 psi. On the back of the case is a vent, and a connection for the pressure line to the bourdon tube.

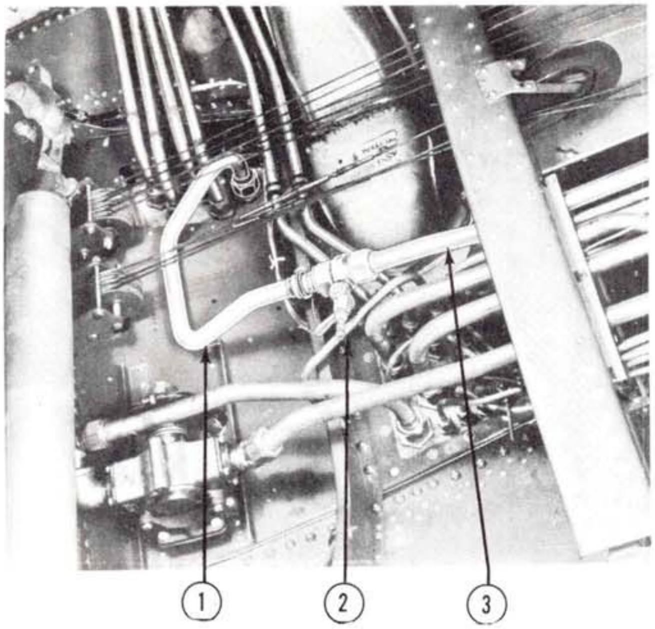


Figure 560—Auxiliary Check Valve Installed

1. Line-Distributor Valve to Check Valve
2. Parker Plug Valve and Union
3. Line from Check Valve

Note

When the system is operating, the gage will not give a constant recording of 8 psi due to fluctuation of air pressure. However, it must reach 8 psi at peak of each inflation. On some airplanes, the pressure gage records to only 10 psi.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Remove mounting screws.

(2) Disconnect gage line to air filter.

b. DISASSEMBLY.

WARNING

Disassemble gage at depots only.

(1) Remove two screws in case.

(2) Remove glass covering by removing snap ring.

(3) Remove bourdon tube.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replace rather than repair gage.

4. TEST BEFORE INSTALLATION. — Test gage on a test stand.

5. ASSEMBLY AND INSTALLATION. — Reverse removal and disassembly procedure.

6. TEST AFTER INSTALLATION. — Test gage in conjunction with de-icer shoe test. (Refer to paragraph 19.*b.*(1)*(j)5.*, this section.)

(i) CONTROL SYSTEM.

1. DESCRIPTION.—A control handle bracket is bolted to the bulkhead aft of the copilot. The handle (figure 559) turns an arm connected at either end to a 1/16-inch cable. The "ON" or outboard cables (H and C, figure 549) are marked with a green band, and the "OFF" cables (L and D, figure 549) with two green bands. The cables are routed through three sets of pulleys (F, figure 549). The first pair is bracketed to the lower section of the bulkhead beneath the handle; the second pair to a brace beneath the floor in the center of the fuselage; and the third to the auxiliary spar, left of the distributor valve. In front of the spar is a turnbuckle (E, figure 549) in each cable to adjust for tension. The cables are connected to either end of the arm of the control unit. (Refer to paragraph 19.*b.*(1)*(e)1.*, this section.)

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) To remove handle, remove bracket attaching screws, disconnect cable ends from arm ends, remove bracket, and separate handle from arm.

(2) To remove pulleys, disconnect turnbuckles and detach pulleys from brackets.

(3) To remove cables, disconnect turnbuckles and disconnect each cable end from each arm end, and pull out cables.

b. DISASSEMBLY. – To disassemble control unit, remove screws from cover, remove arm from shaft, and lift off cover.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Replace frayed or worn cables.

b. Replace worn, crooked, or otherwise faulty pulleys.

4. ADJUSTMENTS.

a. Adjust cable tension by loosening or tightening turnbuckles.

WARNING

While there is no set tension for these cables, be sure they are loose enough to allow easy turning of the control handle, yet not so loose as to drag or respond sluggishly.

5. ASSEMBLY AND INSTALLATION. – Reverse removal and disassembly procedure.

(j) DE-ICER SHOES. *(See N, figure 549.)*

Note

Shoes are identical in meaning to de-icers, or boots; tubes to cells, or bladders.

1. DESCRIPTION.—The shoes are made of soft, resilient rubber and consist of tubes extending lengthwise within rubber strips along the leading edges of the wings and empennage. The wing shoes consist of two outboard and inboard sections; each with three parallel inflatable tubes.

Note

Ice on the leading edges of the wings between the nacelles is partially eliminated by propeller blast.

The empennage shoes consist of two horizontal stabilizer sections and a vertical stabilizer section, each with two parallel inflatable tubes. The center tube of each wing shoe is inflated first, followed by the simultaneous inflation of upper and lower tubes. All stabilizer tubes are inflated at the same time. (Refer to inflation cycle paragraph 19.*b.*(1)*(e)1.*a. to e., this section.) Each shoe contains small breather holes on the top surface to facilitate deflation. As the shoe deflates, the holes permit some of the air to escape, making it easier for the shoe to resume its natural, deflated condition and also making the deflation more complete. The shoes contain beads (thin metal strips) at the edges for better adherence to the leading edge. They also contain clamps at the edges between the fairings and around the landing lights to make a better fit and exclude outside air. Each shoe has extruded metal tubes for the line connections. When installed the rubber of the shoe is stretched to facilitate deflation and insure an even airfoil. As 40 seconds is required to complete the inflation cycle, each tube is under inflation for 8 seconds. Peak of inflation is held for approximately 6 seconds.

2. REMOVAL.

WARNING

Never lean a ladder or anything heavy or sharp against de-icer shoes. Never drag a gasoline hose over them, or otherwise risk impairing the extremely delicate surface. Servicing ladders should be padded. Never allow gasoline or oil to remain on the rubber.

a. Clean surfaces of shoes with soap and water. Use nonleaded gasoline to eliminate oil or grease spots and wipe off thoroughly.

b. Make any necessary repairs to shoes.

c. Disconnect (figure 561) and plug air tube ends.

d. Remove attaching screws.

e. Remove fairing strips (figure 561) and tag them to insure installation in the proper place.

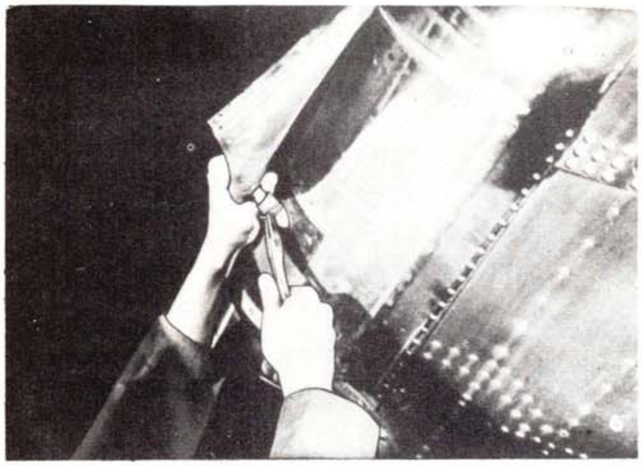
f. Remove (figure 561) clamps.

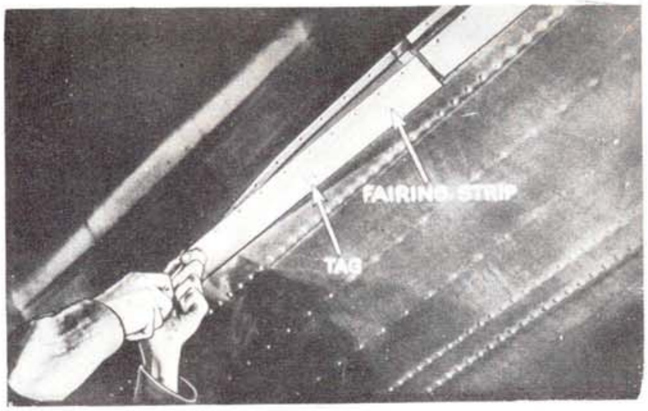
Note

On some airplanes the flaps (aft edges of shoes) are cemented. It will be necessary to soften the cement with a solvent (figure 561) before lifting off flap. After removing shoes, they should be stored because sunlight and heat are injurious and cause rapid deterioration.

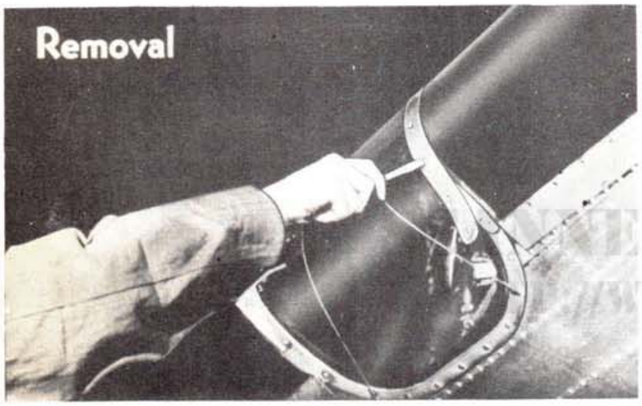
In storing, take the following precautions:

g. Tag air supply hoses (figure 561) and secure them inside the wing. Snap summer caps (coverings over holes in wing) in place.



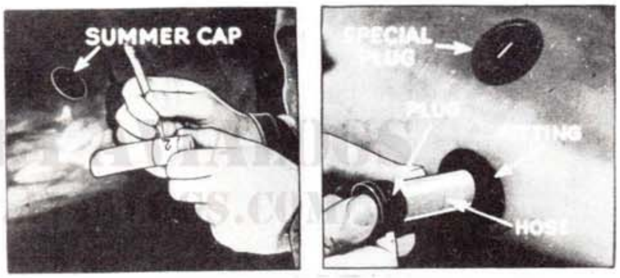


As each fairing strip is removed, tag it for position. When the strip is reinstalled, it can then be put down in its proper place.

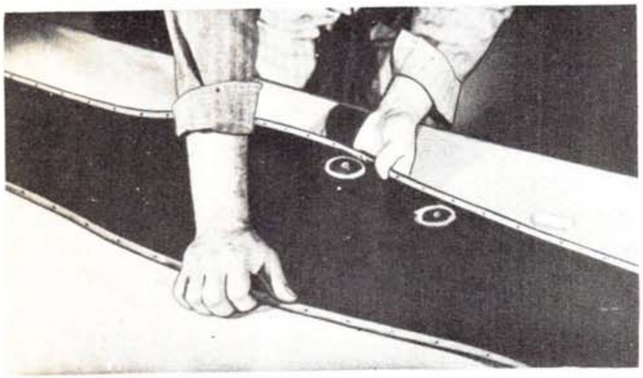


The first step in removing De-Icers is to remove all the screws, end clamps, and fairings that secure the De-Icer.

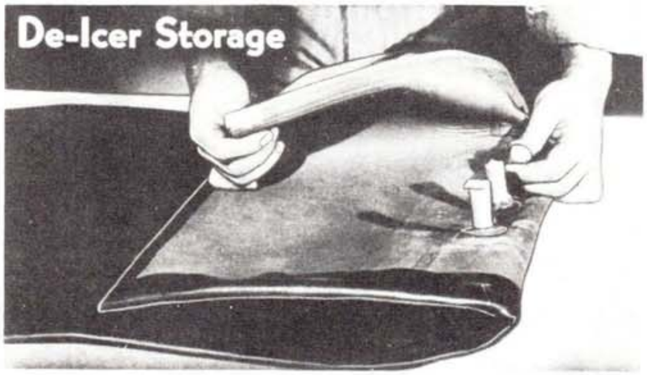
Storage



If the De-Icers are to be stored, tag the hoses and secure them inside the wing. Snap the summer caps in place. In some installations, the hoses are not removed from the wing fitting. Special plugs are inserted in the hose and pushed flush with the fitting in the wing.



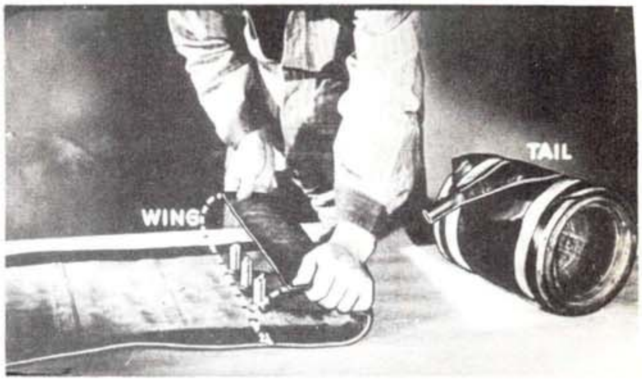
Just as the metal skin may be damaged, so may the De-Icers be injured. Therefore — at this time they should be carefully inspected and repaired. Stretching the rubber will aid in locating small holes.



Lay out the De-Icer with the outer, or black, side up. Tuck the flaps under. Tape the ends of the metal beads and metal air connections to prevent injury to the rubber.

Figure 561—Installation and Repair of De-Icer Shoes (Sheet 1 of 5 Sheets)

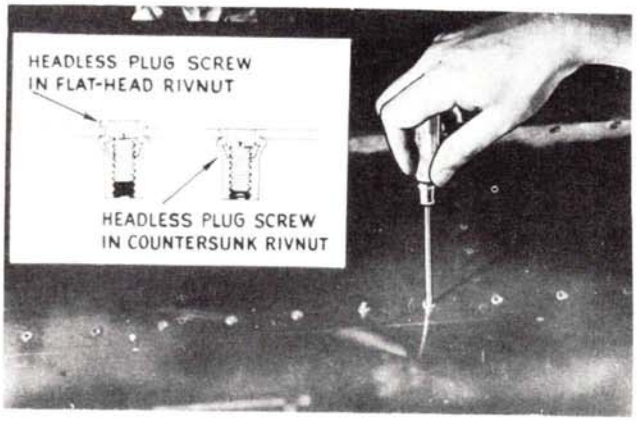
Since the De-Icer moves on the wing skin while operating, talc is used as a lubricant between the wing and the rubber. Rub it on the back of the De-Icer.



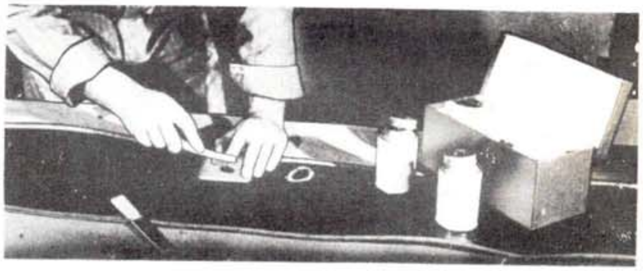
When thoroughly clean and dry, De-Icers may be rolled in a coil, starting with a 4-inch to 6-inch diameter. Wing De-Icers are rolled from the connection end—tail De-Icers from the tip end.

Wrap in heavy paper, turning the edges in to keep out light. Be sure the De-Icer is not wrinkled when it is stored. Store in a cool, dark, dry place. De-Icers will keep indefinitely with these precautions.

After the De-Icers are properly stored, remove the tapes from the wing. Wash off the talc with an approved cleaning agent.


HEADLESS PLUG SCREW IN FLAT-HEAD RIVNUT
HEADLESS PLUG SCREW IN COUNTERSUNK RIVNUT

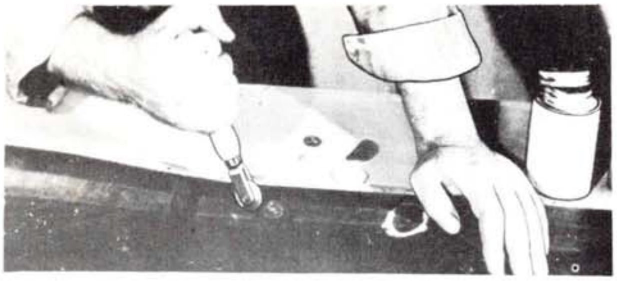
If the De-Icers are to be stored for the summer, plug screws should be installed in the Rivnuts to exclude dirt. Damaged or worn Rivnuts should be replaced



First wash the damaged area with a mild soap and water. Protect the De-Icer with a buffing shield during the patching operation.

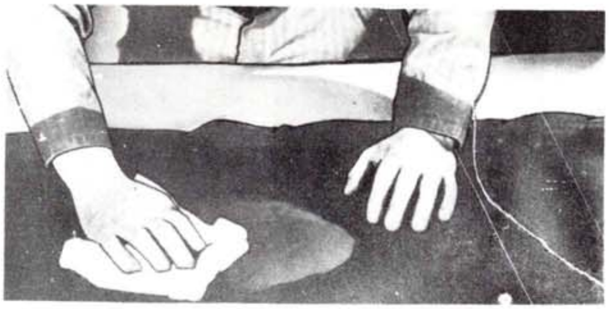
1. Roughen with buffer stick.
2. Clean with benzol.
3. Remove fabric from patch.
4. Use De-Icer cold patch repair kit, AF Stock No. 6600552190.

Figure 561—Installation and Repair of De-Icer Shoes (Sheet 2 of 5 Sheets)



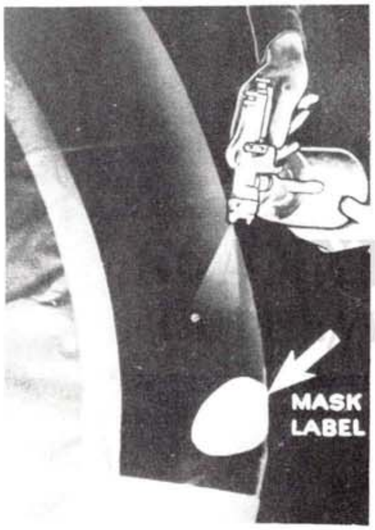
When the cement has become tacky—

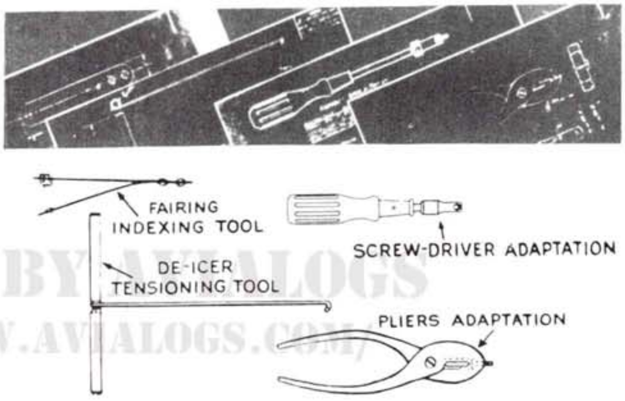
5. Apply the patch.
6. Allow 15 minutes for patch to set, then clean with benzol.
7. Brush on conductive cement, A-56B, to restore surface.



To prepare the De-Icer for resurfacing, first scrub its outer surface with cheesecloth moistened with butyl acetate, or isopropyl acetate, to clean and smooth the old surface.

Mask the De-Icer label. Then spray a smooth coat of conductive cement, A-56B, on the De-Icers. Badly worn areas may require a second coat or more frequent applications.

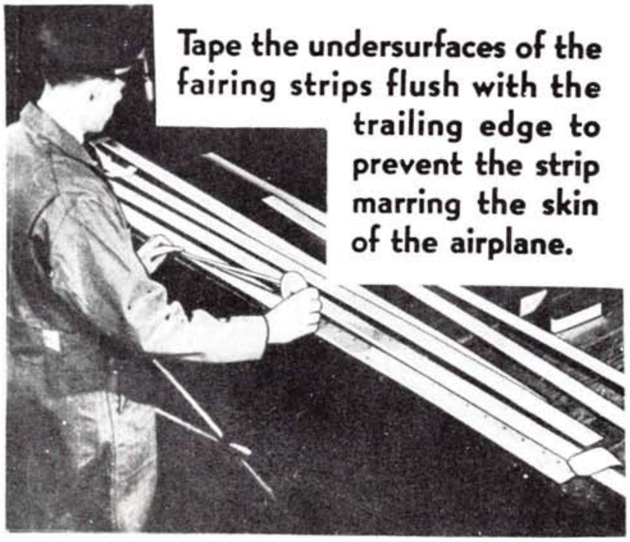



FAIRING INDEXING TOOL
SCREW-DRIVER ADAPTATION
DE-ICER TENSIONING TOOL
PLIERS ADAPTATION

Special tools used in installing De-Icers obtainable from AF stock—screw driver, No. 3300-44A9408 —tension hook, No. 8003-44A9408.

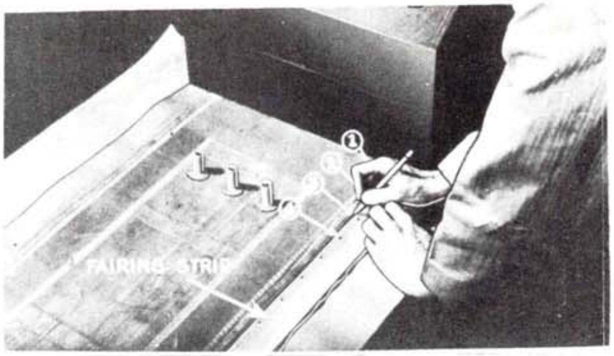
Installing New De-Icers

To prepare the airplane for new De-Icers, apply adhesive tape over all skin laps and rivet heads in the De-Icer area to prevent localized wear on the undersurface of the rubber. Around salt water use a coat of P-27 primer on the skin under the De-Icer.

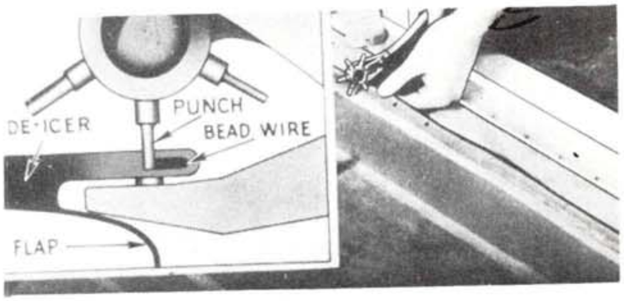


Tape the undersurfaces of the fairing strips flush with the trailing edge to prevent the strip marring the skin of the airplane.

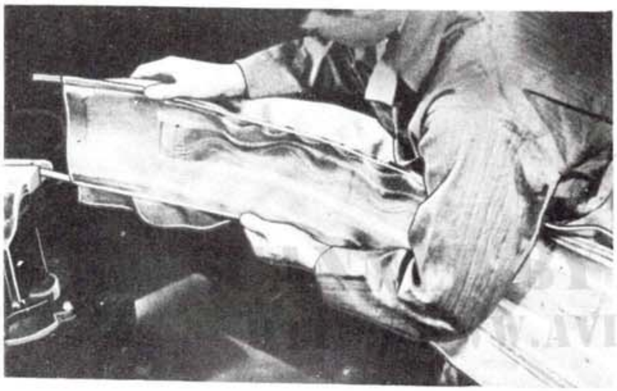
Figure 561—Installation and Repair of De-Icer Shoes (Sheet 3 of 5 Sheets)



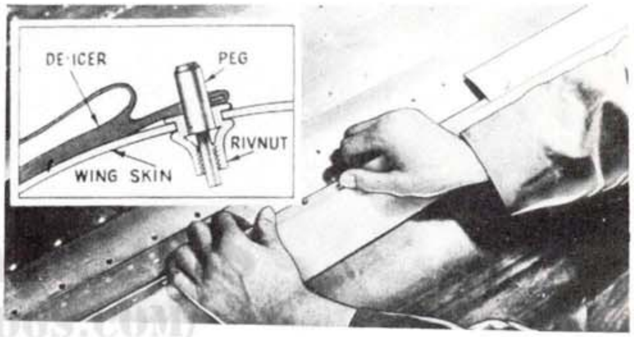
Lay the proper fairing strip on the edge of the De-Icer as shown. Line up the No. 4 hole of the fairing strip with the No. 4 mark on the De-Icer. The layout of the holes is now marked directly from the fairing strip.



Punch the holes in the fabric-reinforced rubber so that the metal bead will bear against the screws when installed. (Around the tip curve the De-Icer should be punched only after the straight part has been located on the wing.) Be careful not to damage the flap.

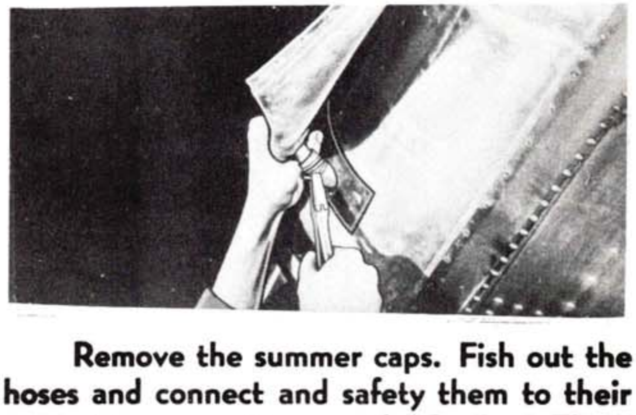


Slide the rubber back on the beads to curve the tip of the De-Icer to conform roughly to the wing-tip curve.



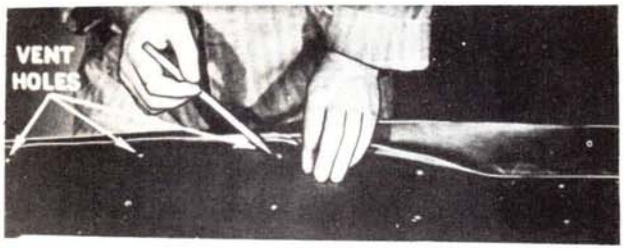
Place position pegs (AF Stock No. 8003-43-A 19655) in the rivnut holes on the top of the wing. Hang the De-Icer and fairing strips on these position pegs. Be sure that the De-Icer is in its proper position at the air connections.

Attach the fairing strips and De-Icer with special attaching screws, removing the pegs as the screws are driven. Do not tighten the screws. Leave them loose.

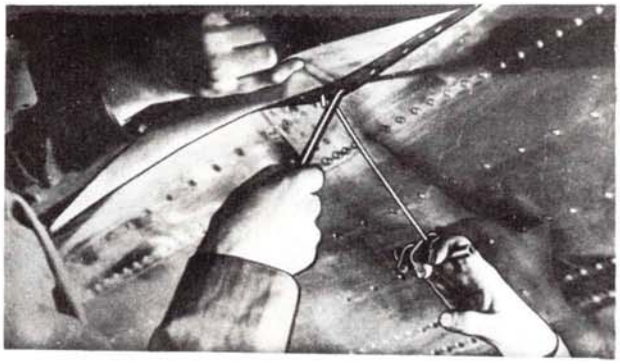


Remove the summer caps. Fish out the hoses and connect and safety them to their respective connections on the De-Icer. Then, adjust the connections properly in place in the wing.

Figure 561—Installation and Repair of De-Icer Shoes (Sheet 4 of 5 Sheets)

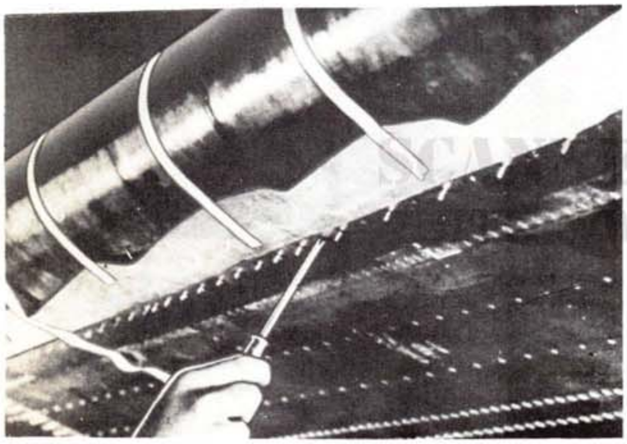


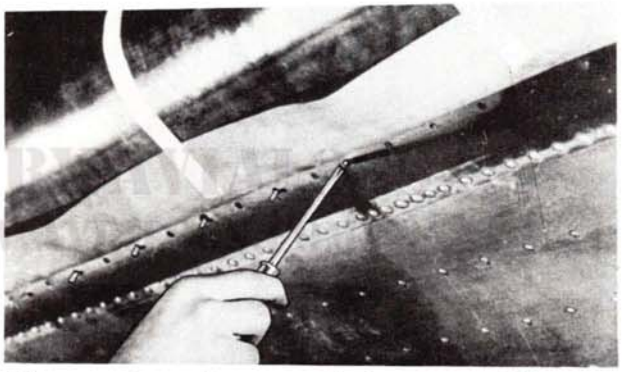
The bottom holes are marked the same as the to holes. Because the vent holes are located on th top side of the De-Icers, the right- and left-han De-Icers can be easily identified.



Starting near the connections, stretch the De-Ice around the leading edge with a tensioning hook and peg it into place with a position peg holder and a tool for pegging.

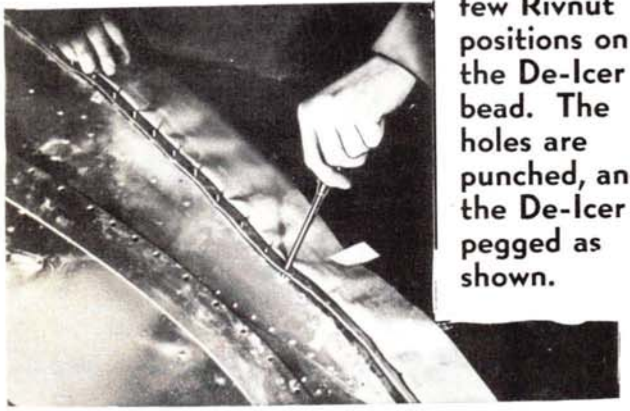
Replace every other peg with a screw and tighten securely.

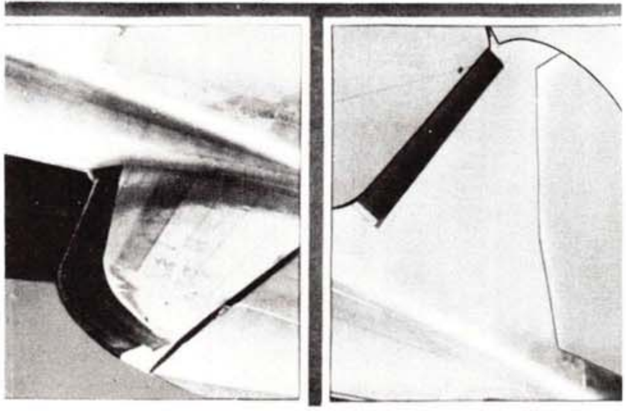




Now, replace the rest of the pegs with screws and be sure that they are all tight. Finally, tighten all screws along the top attachment.

Now, start on the tip curve. Hold the De-Icer up to the line of Rivnuts. Then mark the first few Rivnut positions on the De-Icer bead. The holes are punched, and the De-Icer pegged as shown.





Apply the horizontal and vertical stabilizer De-Icers in the same way.

Figure 561—Installation and Repair of De-Icer Shoes (Sheet 5 of 5 Sheets)

h. Be sure shoes are entirely clean. Inspect for holes (figure 561) and damage. Repair if damaged.

i. Lay shoes (figure 561) out with the outer or black side up.

j. Tape metal parts to prevent injury to the rubber.

k. Sprinkle talc (figure 561) on underside of shoe.

WARNING

Never use a liquid mixture of talc on the shoes.

l. Roll shoes (figure 561) in a coil (4 to 6 inches in diameter). Wing de-icers are rolled from the connection end; empennage de-icers from the tip end.

m. Wrap in heavy paper (figure 561), closing in ends. Be sure the shoe is not wrinkled and that it is stored in a cool, dark, dry place.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. MAINTENANCE REPAIR.

(1) LEADING EDGES. – After the de-icers have been stored, take the following precautions (figure 561) with surface leading edges:

(a) Remove all tapes.

(b) Wash off all talc.

(c) Plug all rivnuts (figure 561) with special screws (No. 37B3822-1 headless screws) to prevent the rivnut threads from gumming or corroding and to keep dust from entering wings and stabilizers.

(2) CLEANING DE-ICER SHOES.

(a) Remove oil and dirt by washing with neutral solution of soap and water.

(b) If necessary, use high-test gasoline; but dry immediately to prevent penetration into rubber.

(c) Rub lightly to avoid removing conductive surface.

(3) PUNCTURES.

(a) Clean surface (figure 561) in vicinity of damage with soap and water and wipe dry.

Note

A de-icer repair kit (figure 561) is carried in the baggage compartment of the airplane for minor repairs in the field. Major repair should be made at "depots" or rubber factories only. Patching may be done with shoe either on or off the wing.

(b) Select correct size patch.

(c) Cut out a shield of cardboard or similar material and place over tear or hole to protect surrounding area. Hold shield in place during the following operations:

1. Rub with cloth soaked in benzol to soften and remove conductive surface.

2. Roughen surface with wire buffer.

3. Smooth out with emery buffer so surface has been removed approximately .003 inch.

4. Clean with benzol and allow to dry.

(d) Apply one coat B. F. Goodrich No. 1 cement and allow to dry.

(e) Remove fabric backing from patch and apply one coat No. 1 cement to exposed surface.

1. Keep tacky surface of patch clean after removing fabric and cementing.

2. Allow to dry. Unlike glue, rubber cement must be thoroughly dry before patch is applied.

(f) Apply patch to de-icer shoe.

1. Stick center or edge of patch in place and work remainder down. Do not trap air.

2. Roll down with a metal roller.

3. If edges are not tight, recement and allow to dry. Then roll down.

(g) Allow repair (figure 561) to set for 10 or 15 minutes. Then wipe patch and surrounding area lightly with benzol to remove all excess cement.

CAUTION

Don't patch too long a hole by the above described method. While it is usually limited to tears ¾ inch in length or less, longer tears may be so patched in emergencies. If the damage is such that it should not be repaired by the above method, repair material may be cut from the sheet rubber or rubberized fabric in some de-icer repair kits. For damage in fabric reinforcement, or at right angle to the center line of the de-icer shoes, or for emergency repairs to tears exceeding ¾ inch, repair as outlined and reinforce with rubberized fabric on the back of the de-icer. Apply two coats (figure 561) of the No. 1 cement rather than the one described in the first method. Apply it to the roughened surface of the rubberized fabric. The fabric should be applied with the stretch at right angles to the centerline of the de-icer shoe. Small punctures in the tubes should be patched on the exposed surface. However, when inflatable tubes are cut or torn, fabric reinforcement should be applied inside before the outer surface is patched.

(4) RESURFACING DE-ICER SHOES.– De-icer shoes often contain static electricity. Surfaced conductor shoes discharge the electricity in an even flow. Unsurfaced shoes, being poor conductors, discharge the electricity in uneven prolific spurts, *which results in puncturing the shoes and in interfering with radio receptivity.*

CAUTION

Refueling before eliminating static electricity is extremely dangerous.

When the surface has become abraided, it may be restored to conductivity by applying A56B conductive cement as follows:

(a) Wet a clean soft cloth with butyl acetate (figure 561) or isopropyl acetate.

Note

Isopropyl acetate is preferable in cold weather.

(b) Scrub surface to be recoated vigorously to remove all loose particles and smooth any wrinkles in the coating.

(c) Mask de-icer label (figure 561) and along edge of de-icer shoes to shield skin while spraying.

(d) Spray shoe with two light coats of A56B conductive cement. Allow ample time to dry between coats.

(e) Avoid contact with surface until dry.

(f) The airplane should remain in a warm place as long as possible after application.

Note

Conductive cement will air cure at room temperature in about 24 hours. Consequently, it is desirable to resurface de-icer shoes before other servicing of the airplane.

(5) SPLICING DE-ICER SHOES.

Note

Splicing shall be resorted to only in extreme emergency.

(a) Install parts to be spliced onto wing or stabilizers with the ends overlapped.

(b) Cut through both layers across the overlapped ends. Take care to avoid injuring skin.

(c) Free the cut ends amply to allow roughening of an area 3 inches wide on the underside of each. Remove debris.

(d) Apply a uniform coat of B. F. Goodrich cement to both of the roughened surfaces and to the frayed side of a rubberized fabric strip, allowing the cement to dry to the "tack free" stage (about 2 hours). Apply two such coats.

(e) Place the rubberized fabric directly against the skin with the center in line with the splice and the cemented side out. Do not stretch fabric while applying.

(f) Roll down the ends of the shoes with metal roller and seal the splice with 2-inch sealing strip. Take care to seal spaces between the tubes when the splice is across a section of the shoe that has more than one tube, because a leak at this point will decrease or prevent effective operation of the shoes.

(6) FAIRING STRIPS.—Repair slightly damaged fairing strip or cap.

b. REPLACEMENT.

(1) Replace de-icer shoes beyond repair.

(2) Replace damaged or worn rivnuts. Use a heading tool.

(3) Replace fairing strips or caps beyond repair.

CAUTION

Locate holes in blank fairing strip with indexing tool (figure 561) to insure an accurate fit. Use only correct fairing strip for each section.

(4) Replace damaged plug screw.

(5) Replace damaged tube connection.

4. ASSEMBLY AND INSTALLATION.

a. INSTALLATION.

(1) Remove plug screws and inspect rivnuts for condition and security.

(2) Rub between rivnuts with sandpaper or 2/0 grade emery cloth.

(3) Tape over all rivnuts (figure 561) and seams protruding above skin surface to prevent wear on the under surface of the rubber.

Note

Around salt water, use a coat of P-27 primer on the skin under the de-icer shoes.

(4) With ¼-inch tape, tape (figure 561) the undersurfaces of all fairing strips flush with the trailing edge to prevent the strip from marring the skin.

(5) Paint around the three airline holes with No. 4 Fairprene and let area dry until it becomes tacky.

(6) Paint rubber pad with the same paint and place pad over holes.

(7) Paint the entire area to be covered by the de-icers with a solution of talc and zobiol for shoe lubrication.

Note

A mixture of talc and nonleaded gasoline will suffice.

CAUTION

Use thinner rather than gasoline if installation is inside of a hangar.

(8) Plug lines from shoes to distributor valve to keep dirt out. Be sure the lines are clean.

(9) Blow out air lines to be sure shoes are free of dirt.

(10) Lay proper (figure 561) fairing strip (strip should be tagged at removal) on the edge of the de-icer shoes.

(11) Punch holes (directly in line with the holes in the fairing strip) in the fabric-reinforced rubber (figure 561) so that the metal bead will bear against the screws when installed.

Note

This would apply only to new de-icer shoes.

Shoes formerly installed will have the holes already punched.

(12) Slide (figure 561) the rubber back on bead about 3 inches to curve the tip of the shoe to conform roughly to the wing tip curve.

WARNING

Be careful not to tear or damage the shoe.

(13) Rub talc (figure 561) on back of shoe.

(14) Insert positioning pegs, stock No. 830043A19655, class 18, (figure 561) in the rivnut holes on top of the wing. Place the de-icer shoes and the fairings over these pins, being careful that the shoe is properly fitted at the air connections.

(15) Remove every other pin and insert special attaching screw in its place as the pin is removed. Do not tighten (figure 561) screw. It should be only attached to, and not tightened to rivnut.

(16) Remove (figure 561) the summer cap (airhole plug) and pull out air supply hoses. Connect them from the de-icer shoe connections to the lines from the distributor valve. Safety them and be sure terminals are securely wired to prevent leakage.

(17) Insert pins (figure 561) on bottom of wing.

(18) Using a tensioning-hook, (figure 561), stock No. 800343A19653, start at air connections and stretch shoe around the leading edge and over pins at the bottom.

(19) Install fairing strips over bottom pins.

(20) Replace every other pin (figure 561) with a screw and tighten thoroughly.

(21) Replace the remaining pins (figure 561) with screws and tighten them securely.

(22) Tighten screws at top attachment. Insert remaining screws and tighten them.

(23) Cement with No. 4 Fairprene at landing light, attach angle, wing tip, fairing cap, between fairing strips, and anywhere along fairing edges where fit is slightly uneven.

Note

On some airplanes, the de-icer shoes incorporate flaps aft of the fairings. The flaps should be cemented to the wing surface with an EC-31 cement or equivalent.

(24) Proceed with wing tip curves (figure 561) as with top and bottom of wing. Be careful to fit the curve of the tip and to keep all puckers at right angles to the leading edge.

(25) Place curved fairing strip over pins. Replace pins with screws as before, and tighten screws progressively toward the tip.

(26) Complete procedure as on top and bottom of wing.

Note

Roll out wrinkles.

(27) Apply empennage shoes (figure 561) in the same way.

Note

Some prefer to put bottom of shoe on first, reversing procedure in foregoing paragraph.

5. TEST AFTER INSTALLATION.

a. Connect an auxiliary air line with a pressure regulating valve to the inlet port of the distributor valve, or to any part of either line between either pump and the distributor valve.

Note

There is a specific valve for this purpose. (Refer to paragraph 19.*b.*(1)*(k)1.*, this section.)

If an auxiliary air line is unavailable, air may be supplied in the usual manner from the vacuum pump or pumps with an engine running or both engines running.

b. Set the pressure regulator at 10 psi. *(Pressure regulator on auxiliary system.)*

c. Turn de-icer system control handle to "ON."

d. Turn on air supply.

e. Observe de-icer gage. If pressure exceeds 8 pounds at peak of inflation cycle, turn control handle "OFF" immediately.

f. Turn the adjusting screw, regulator screw on the air filter, counterclockwise (paragraph 19.*b.*(1)*(g)1.*, this section) to relieve pressure.

g. Adjust the regulator screw until the pressure on the gage records 8 pounds.

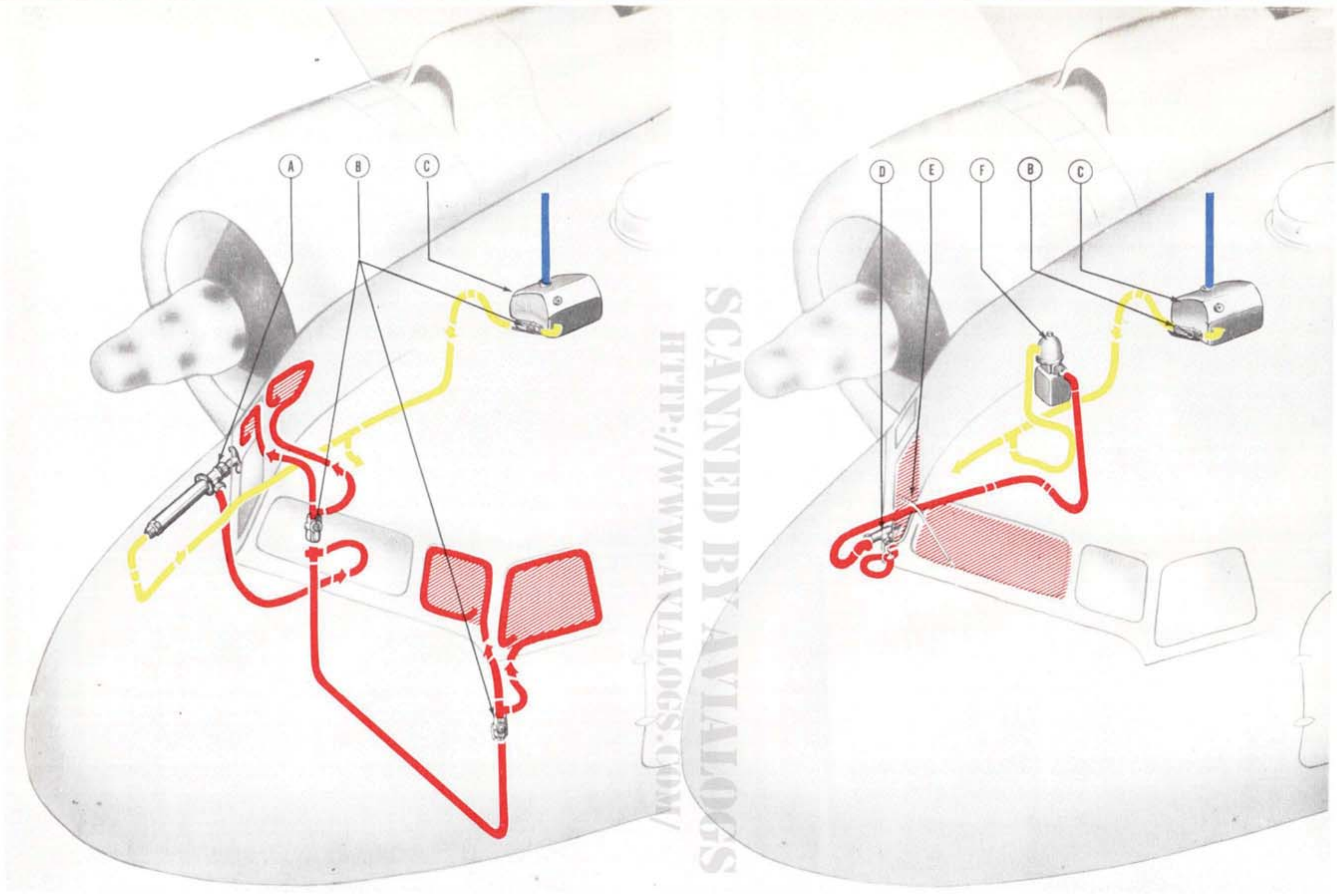
h. Check the pulsations of the shoes for proper inflation cycle. (Refer to paragraph 19.*b.*(1)*(e)1.*, this section.)

WARNING

If any tube inflates or deflates too slowly, or there is gurgling in the system, disconnect and clear the lines. Inflation and deflation must be precise and complete since they determine the de-icer effectiveness and are definitely a part of the airfoils.

(k) AUXILIARY VALVE. *(See figure 560.)*

1. DESCRIPTION.—In the aft inboard side of the right nacelle is a Parker plug valve used essentially for testing. One port is screwed into a union in the pressure line, and the other port is free for the attachment of an auxiliary pressure line when it is desirable to test the system without using either vacuum pump. (Refer to paragraph 19.*b.*(1)*(j)5.*, this section.) The manually operated valve may also be used to drain the system. A lock wire secures the handle to prevent leakage. (For more detailed description, disassembly etc, refer to paragraph 19.*c.*(1)*(c)1.-7.*, this section.)



HAND PUMP IN OPERATION DRAWS ALCOHOL FROM TANK AND EJECTS IT UNDER PRESSURE ON ALL FOUR SIDE WINDOWS

COLOR CODE:

🟨 ALCOHOL SUPPLY
🟥 PRESSURE.
🟦 VENT

ELECTRIC PUMP IN OPERATION DRAWS ALCOHOL FROM TANK AND EJECTS IT UNDER PRESSURE ON BOTH FRONT WINDSHIELDS

Figure 552—Windshield Anti-Icer System

KEY TO FIGURE 562

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
A	44355	Hand Pump	1
B	715FT-4D	Parker Shut-Off Valve (Tank)	1
	702-GG-4D	Parker Shut-Off Valve (RH)	1
	715GT-4D	Parker Shut-Off Valve (LH)	1
C	5136139-6	Tank Assembly	1
	AF909-24	Plug	1
D	B12306	Needle Valve	1
E	4141107-10 (Line)	Horn Extension	1
F	D13382	Electric Pump	1

2. REMOVAL.—Unscrew valve from tee in line.

(l) DRAIN COCK.

1. DESCRIPTION.—A few feet aft of the lavatory door, in the bend of the de-icer line (below the floor and at the lowest point in the system) is a drain cock. It consists of a heavy metal plug with a tee-shaped handle screwed into it to secure it. The handle has bonding wires extending from its terminals. The plug screws into a tee in the main line. As there is bound to be some condensation in the line at the lowest point, removing the plug will drain it. This drain cock is accessible through a round corner plate in the fuselage belly. (See figure 7.)

2. REMOVAL.

a. Remove bonding wires from handle.

b. Unscrew plug from tee.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replace plug or handle unit having torn or worn threads or otherwise damaged.

(m) LINES.

1. DESCRIPTION. — The pressure lines are aluminum with hoses at vital connections. They carry a light green and blue banding to distinguish them from vacuum lines which are banded white and light green.

WARNING

The usual precautions in handling aluminum lines and hoses must be taken here.

2. REMOVAL.—Disconnect lines at connections.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Remove slight scratches with fine emery cloth. Then polish them with oiled crocus cloth.

b. Replace badly bent or cracked lines.

c. ANTI-ICING.—When heat or alcohol is used to prevent ice formation on various parts of the airplane, such ice-preventive measures are called anti-icing (refer to paragraph 19.*a.* preceding, this section). Two sources of heat are employed in this airplane, either to melt ice or to prevent its formation. One source is the exhaust gases generating hot air. The hot air is used to defrost the windshields (refer to paragraph 16.*d.*(15) and (16), this section); and to maintain carburetor temperature above a fixed minimum (refer to paragraph 6.*c.*(1), this section). The other source is an electrical current generating heat to prevent ice from forming on the pitot tubes (refer to paragraph 14.*c.*(8) and 14.*j.*(8), this section). Alcohol, having a considerably lower freezing point than water, is an ideal anti-icing solvent. Whenever alcohol is mixed with the vapor in the air, the result is the requiring of a much lower temperature to freeze the mixture. This paragraph directly concerns only this principle of anti-icing and includes the windshield, propeller, and carburetor anti-icer systems.

(1) WINDSHIELD ANTI-ICER SYSTEM. *(See figure 562.)*

(a) GENERAL.—The purpose of the windshield anti-icer system is to furnish alcohol to the outside of all six windshields to prevent ice from forming and maintain clear visibility. This system contains two units: the first unit sprays alcohol from a supply tank (C, figure 562) by means of a hand pump (A, figure 562) onto the two right and left side windshields; the second unit spurts alcohol from the same tank by means of an electric pump (F, figure 562) onto the front windshields.

(b) SUPPLY TANK. *(See 2, figure 563.)*

1. DESCRIPTION.—A 6.5 U. S. (5.4 Imperial) gallon dural tank (identical in construction with the drinking water tank) is supported on a cradle in the upper middle section of the baggage compartment. Metal straps, around the tank, are bolted at the ends of the cradle beams to keep the tank rigid. Strips of Adelite protect the tank from the beams. On top are a filler neck and a vent line extending through the top of the fuselage. Underneath are the drain connecting an elbow and manually operated valve allowing entrance of the alcohol from the tank into the supply line.

CAUTION

Fill the tank with isopropyl alcohol, Specification No. MIL-F-5566, only.

2. REMOVAL.

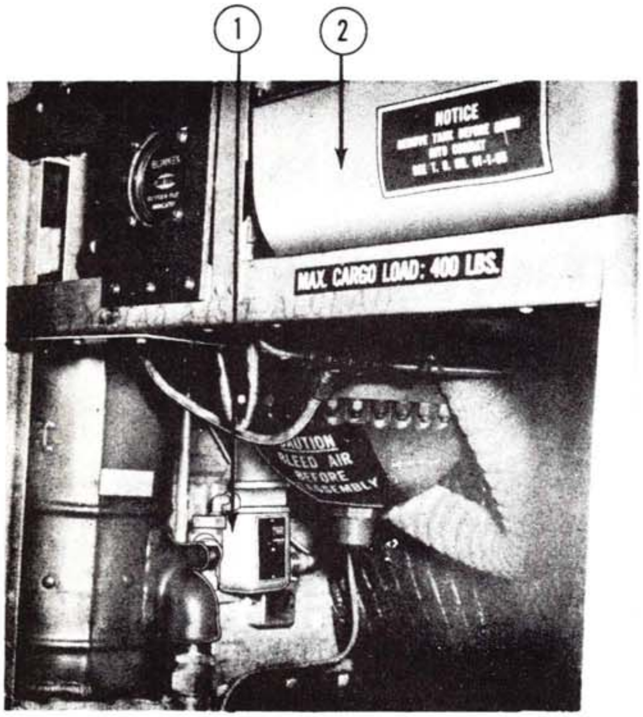


Figure 563—Windshield Anti-Icer System Tank and Electric Pump Installed

1. Electric Pump
2. Tank

a. Disconnect vent line at top of tank and fluid flow line at bottom.

b. Release nuts from ends of metal fasteners attached to ends of straps.

c. Remove straps and lift tank from cradle.

CAUTION

Remove tank before going into combat.

3. MAINTENANCE REPAIR OR REPLACEMENT.

Note

Drain sludge from tank when necessary.

a. MAINTENANCE REPAIR. — Repair small holes by welding.

CAUTION

Alcohol is inflammable. Take necessary precautions.

b. REPLACEMENT.—Replace badly damaged tanks.

4. TEST BEFORE INSTALLATION.—Test by applying an air pressure of 5 psi. A soap solution applied to the surface will bubble in case of leakage.

5. INSTALLATION.—Reverse removal procedure.

6. TEST AFTER INSTALLATION. — After filling tanks, check fittings for leakage.

(c) SHUT-OFF VALVE. *(See B, figure 562.)*

1. DESCRIPTION.—Beneath the tank is a hand controlled, Parker plug valve. It turns the fluid supply from the tank to the supply line "ON" or "OFF." When the control handle is turned, it turns a tapered plug aligning a hole through the plug to the ports of the valve and allowing the fluid held at the inlet port to flow by gravity through the plug and outlet port of the valve. (See figure 564.) The body of the valve contains the inlet and outlet ports; and, at right angles to them, the sleeve, or seat, within which the plug turns. Within the hollow plug is a spring to hold the plug snug against the seat at the handle end. At the handle end of the plug is a hexagonal nut which fits securely within the head of the handle. A screw through the handle head and hexagonal nut secures them to the plug, allowing the plug and handle to turn together. The plug is tapered for tighter and more uniform bearing surface against the seat. At the opposite end of the plug a cap screws into the body. The cap fits against the spring, allowing the spring to expand and press the plug against the handle and sleeve.

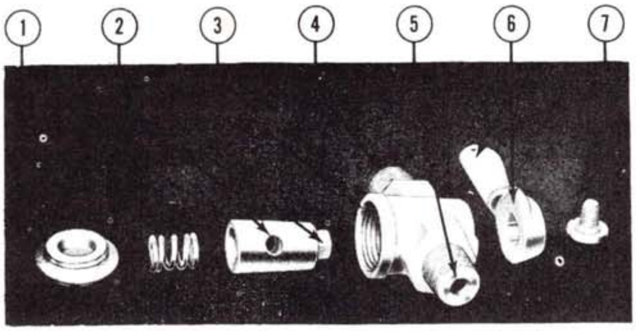


Figure 564—Windshield Anti-Icer System Shut-Off Valve (Exploded View)

1. Cap, Spring and Plug
2. Plug Hole and Hexagonal Nut
3. Sleeve
4. Inlet Port
5. Outlet Port
6. Handle and Handle Head
7. Screw and Washer

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect inlet port from elbow.

(2) Disconnect outlet port from line.

b. DISASSEMBLY.

(1) Remove screw from handle and handle from hexagonal nut.

(2) Unscrew cap from body and remove spring and plug.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Lap slightly rough plug or sleeve.

b. File slightly uneven or worn threads.

c. Replace valve if plug or sleeve cannot be properly lapped.

d. Replace loose or worn spring.

e. Replace worn or twisted washer.

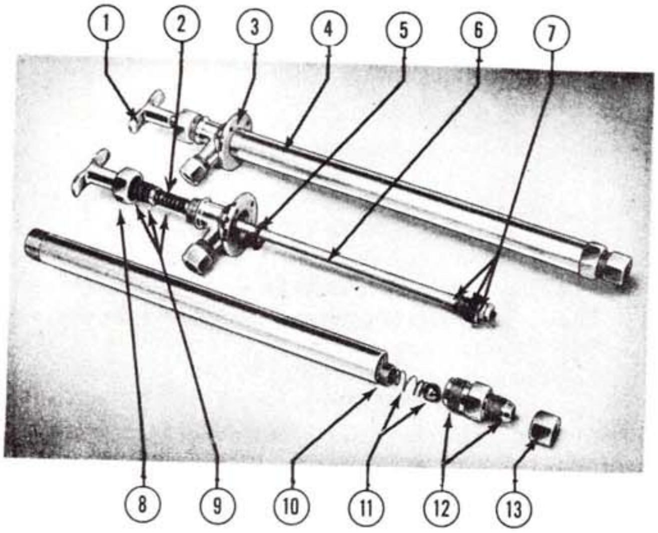


Figure 565—Windshield Anti-Icer System Hand Pump (Exploded View)

1. Handle
2. Outlet Port (Discharge)
3. Mounting Flange (Head)
4. Cylinder
5. Gasket
6. Piston (Plunger)
7. Spring, Valve, Nut, and Lock Nut
8. Packing Gland Nut
9. Packing Gland
10. Guide
11. Spring Loaded Ball
12. Barrel and Ferrule
13. Connector Nut and Inlet Port

f. Replace valve if units have torn threads, or are otherwise badly damaged.

4. ADJUSTMENTS. — If valve is leaking slightly, pull out spring and tighten its tension against the plug at the handle end.

5. TEST BEFORE INSTALLATION.—With valve in water, apply air and note bubbles.

6. ASSEMBLY AND INSTALLATION.—Reverse removal and disassembly procedure.

7. TEST AFTER INSTALLATION.—Observe valve and connections for leaks with system operating.

(d) SIDE WINDSHIELD UNIT.

1. DESCRIPTION. — Fluid flows from the supply tank to the hand pump by gravity. It is pumped through a cross (4, figure 567) under the right rear side windshield to a shut-off valve under the left rear side windshield. Above the cross is a similar shut-off valve (5, figure 567 and 3, figure 566) for fluid flow to the right side windshields. When either shut-off valve is manually opened, the fluid flows through a tee (6, figure 567) connected to the top of either valve. It continues from the tee through two smaller lines which penetrate a hole (figure 567) above the tee and through the fuselage. The hole is reinforced with a grommet and plugged with "dum-dum," a black putty, to prevent the enclosed lines from vibrating. The fluid continues through both lines, one encircling the front, side windshield (2, figure 566); and the other encircling the rear, side windshield (4, figure 566). Sealed at the ends, both lines contain perforations around the windshields to release the fluid onto the windshields. As the fluid sprays onto the windshields, the air stream spreads it over their surfaces.

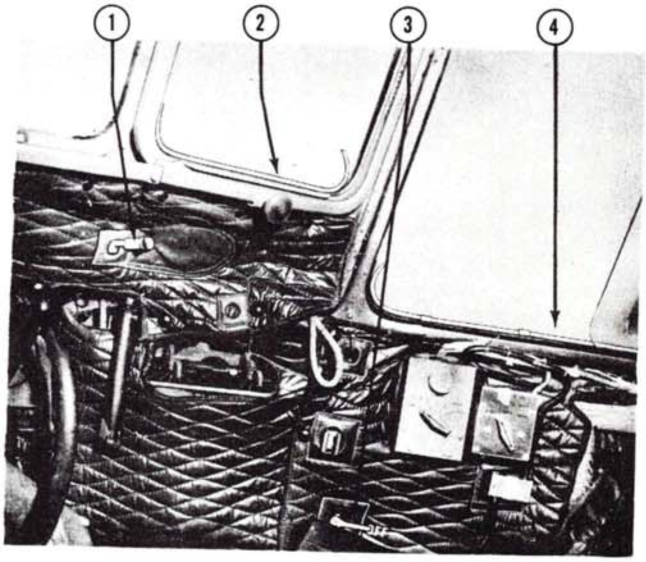


Figure 566—Windshield Anti-Icer System Hand Pump Installed

1. Hand Pump
2. Right Front Side Windshield Line
3. Side Windshield Fluid Shut-off Valve
4. Right Rear Side Windshield Line

2. HAND PUMP. *(See 1, figure 566.)*

a. DESCRIPTION.—The pump, supported by two brackets forward and to the right of the copilot, is manipulated by the latter. The unit consists of a handle (1, figure 565) attached to a piston or plunger which is pulled and pushed within a cylinder. The cylinder contains a spring-loaded ball check at the forward end. On the plunger are a Neoprene moulded valve (Neoprene washers); and a packing gland (washers) to prevent fluid from leaking and provide compression. When the plunger is pulled back by the handle, the valve grips the walls of the cylinder and closes. This creates a low-pressure area back of the spring and ball, relieving them and allowing the fluid to enter the forward end of the cylinder. When pushed forward, the valve, under the pressure of the fluid it is compressing in the cylinder, opens or separates from the walls of the cylinder, and allows the fluid to flow to the back of the cylinder. On the second back stroke, the fluid in back prevented by the closing of the valve from re-entering the front of the cylinder, is withdrawn

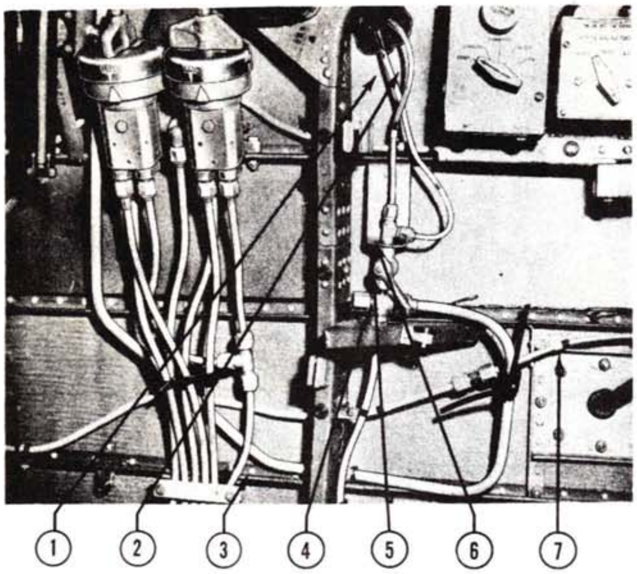


Figure 567—Windshield Anti-Icer System Cross, Valve and Tee Installed

1. Line to Forward Side Windshield
2. Line to Aft Side Windshield
3. Line—Hand Pump to Cross
4. Parker Cross and Cap
5. Parker Shut-Off Valve
6. Tee
7. Line to Needle Valve

from the back (head) of the pump into the discharge line. The pump has an estimated pressure of 150 psi.

Note

> Arrangement of the units in the packing gland assembly has been changed, resulting in the pump's pulling practically twice the 150 psi for which it was originally designed. Figure 565 shows the (correct) arrangement.

b. REMOVAL AND DISASSEMBLY.

(1) REMOVAL.

(a) Remove screws attaching pump to front bracket.

(b) Remove screws attaching pump bracket to light bracket. Remove pump.

(2) DISASSEMBLY.

(a) To disconnect cylinder from plunger, unscrew, by hand, cylinder end from head or mounting flange.

(b) To remove plunger-valve assembly, unscrew two nuts and slip parts from front end of plunger.

(c) Slip off mounting flange from front end of plunger.

(d) Slip off units of packing gland assembly.

(e) Unscrew packing gland nut and handle.

(f) To remove ball and spring, unscrew connecting nut from valve barrel (inlet port) and unscrew barrel from cylinder.

c. MAINTENANCE REPAIR OR REPLACEMENT.

(1) MAINTENANCE REPAIR. — Thread-lube cylinder threads often to prevent leakage.

WARNING

> Keep threads of all units thoroughly greased.

(2) REPLACEMENT.

(a) When the Neoprene plunger-valve becomes twisted, reversed or expanded, it must be replaced. Don't try to repair it.

(b) Replace worn or sprained washers, springs, and gaskets.

(c) To prevent leakage, replace all working parts of the packing gland when even slightly worn, damaged, or twisted.

(d) Replace rough ball or valve or bent spring.

(e) Replace any part with worn or torn threads.

d. ADJUSTMENTS.—After thread-lubing threads or disassembling pump, cylinder must be screwed into head of pump to assemble pump, to maintain compression, and to stop leakage.

WARNING

> Don't tighten cylinder end excessively into head of pump as there is danger of crushing gasket and flaring cylinder end. Tightening as much as possible by hand will be sufficient.

e. TEST BEFORE INSTALLATION. — Place front end of pump in fluid and test it for operation and leakage.

f. ASSEMBLY AND INSTALLATION. — Reverse removal and installation procedure.

g. TEST AFTER INSTALLATION.— Operate pump and note leakage at fittings.

3. SHUT-OFF VALVES.

(See 3, figure 566 and 5, figure 567.)

a. DESCRIPTION.—The valves open or close the supply of fluid from the hand pump to the side windshields. There are manually operated Parker plug-type valves. (For more detailed description, disassembly, maintenance repair, etc , refer to paragraph 19.*c.*(1)*(c)1.-7.*, this section.)

b. REMOVAL.

(1) RIGHT VALVE. — Disconnect lines from tee above valve and tee from valve. Disconnect valve from cross.

(2) LEFT VALVE. — Disconnect lines from tee above valve, and valve from line below.

4. LINES.

a. DESCRIPTION.—All lines are aluminum. Lines in front and back of the pump are large to off-set the unusually high pressure in the pump; and the tubing around the windshields is small to provide a more uniform distribution of fluid over the windshields.

b. REMOVAL.

(1) Disconnect lines at connections.

(2) Remove Adel clips holding lines to fuselage frames.

(3) Remove metal clips holding tubing to windshield frames.

c. MAINTENANCE REPAIR OR REPLACEMENT.

(1) MAINTENANCE REPAIR.

(a) Small holes may be welded.

(b) Remove scratches with fine emery cloth.

(c) If perforations in tubing become clogged, snip off the welded end of the line and blow it out. Then pinch the end shut with a hand vise or heavy pliers.

Note

> Welding flux from the welded end collects in the line and clogs the perforations. In later airplanes the line is clamped to seal the end rather than welded.

(d) Blow out tubing with air to thoroughly clean perforations.

(2) REPLACEMENT.—Replace cracked, bent, or corroded lines.

d. INSTALLATION. — Reverse removal procedure.

e. TEST AFTER INSTALLATION.—Test fittings and lines for leakage.

(e) FRONT WINDSHIELD UNIT.

1. DESCRIPTION.—Fluid is pumped from the tank by and through an electrically driven pump, through a control needle valve (D, figure 562) on the instrument panel, through the perforations of the horn (tubing in front of windshields, E, figure 562, and figure 437) and onto the front windshields. The pump is energized from an electrical switch on the pilot's electrical control panel (refer to paragraph 14.*l*(4), this section). The amount of fluid flow is regulated by a knob (1, figure 569) on the instrument panel operating the needle valve and controlled by the pilot. To the right of this knob is a similar knob (2, figure 569) connected to a similar valve regulating the flow of hydraulic fluid to the windshield wipers (1, figure 570). The air stream picks up the fluid as it spurts onto the windshields and spreads it over the entire windshield surfaces.

CAUTION

> Introduce alcohol to windshields before starting windshield wipers. Windshield wipers operating over a film of ice are ineffective.

2. ELECTRIC PUMP. *(See 1, figure 563.)*

a. DESCRIPTION.—The (2.7 lb.) Marquette alcohol pump is bolted to a dural plate bolted to the aft side of the bulkhead behind the copilot. (See figure 568 for disassembly.)

Note

> In some airplanes it is bolted to the outboard side of the tuning case.

It is termed "autopulse" because it is a self-pulsation pump. The maximum pressure output is about 3 psi. As the fluid from the supply line enters the right side of the pump, it unseats a spring loaded valve, allowing it to enter bellows beneath the valve. The bellows are held up in their natural position by a spring extending from the middle base of the bellows, through the middle of a coil beneath it, to the bottom of the pump. Above the spring are lower and upper contact points; the points being incorporated with an armature and magnet. When the magnet is energized by the contacting of the points, it separates the points and forces the spring down. The magnet is de-energized by the separation of the points, allowing the spring to automatically rise again and reestablish the contact. As the bellows retains its natural position, it opens and consumes the fluid from the supply valve. As it rises, it squeezes together, seating the intake valve, and discharging the fluid through an opening to the inside of the filter screen above the bellows. The fluid sprays through the screen to the filter bowl, leaving its deposit on the inside of the screen. It re-enters the screen at the top through two tubes extending through the screen to the discharge valve. The discharge valve is identical with the supply valve except that the seating is reversed. When one opens, the other closes. The fluid continues through the tubes and out the discharge valve.

b. REMOVAL AND DISASSEMBLY.

(1) REMOVAL.

(a) Remove two bolts in pump mounting plate.

(b) Remove bolts attaching mounting plate to bulkhead.

(c) Remove inlet and outlet lines. Remove pump.

(2) DISASSEMBLY.

(a) FILTER.—Unscrew cap at top and remove screw attached to filter base, washer, gaskets, screen spring, and bowl.

(b) VALVES.—Remove filter. Remove two screws connecting bellows ring to pump base. Remove lock washers. Remove pump base assembly from filter base. Remove valves.

(c) COVER PARTS. — To remove cover, remove cover screws at bottom of pump, washers, and cover.

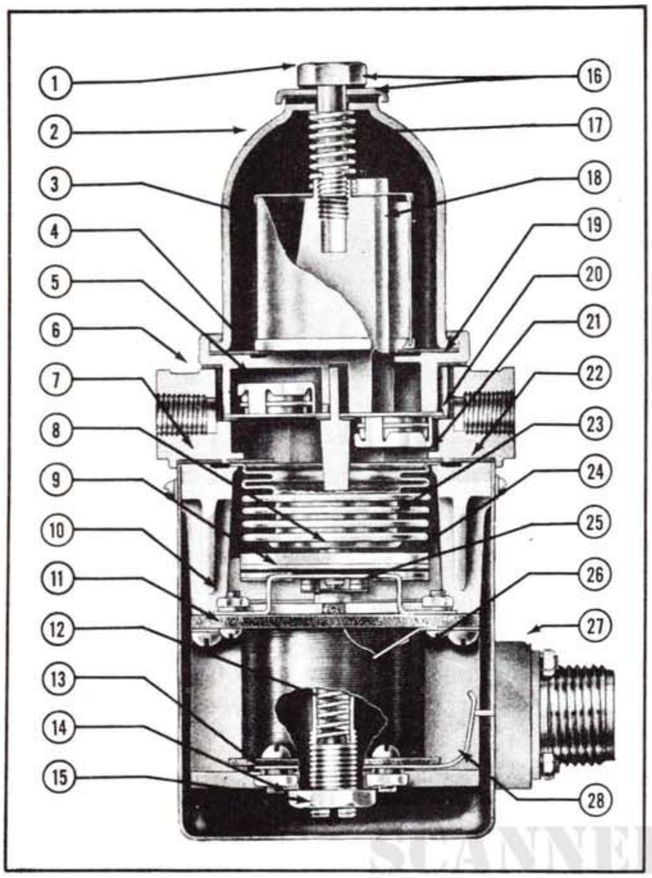


Figure 568—Windshield Anti-Icer System Electric Pump (Cutaway View)

1. Cap Screw
2. Filter Bowl
3. Filter Screen
4. Bowl Screen Gasket
5. Valve Assembly
6. Pump Base
7. Airseal Gasket
8. Drive Screw Nut
9. Upper Contact
10. Hex Steel Nut and Lock Washer No. 4
11. Steel Screw and Lock Washer No. 10
12. Drive Spring
13. Hex Steel Nut and Lock Washer No. 6
14. Pressure Nut
15. Pressure Screw
16. Cap Screw Washer and Gaskets
17. Screen Retaining Spring
18. Filter Base
19. Filter Base Gasket
20. Valve Gasket
21. Bellows Gasket
22. Bellows Ring
23. Bellows
24. Armature
25. Lower Contact
26. Coil Assembly
27. Binding Post Assembly
28. Contact Arm

(d) UPPER CONTACT POINTS.—Remove nuts, screws and lock washers connecting upper, contact plate to plate above coil.

(e) COIL.

1. To separate coil from pump, remove pressure screw at base of spring, pressure nut, and spring. Using ¼ inch magneto wrench, loosen drive screw, nut, and bellows stud. Insert thin screw driver into coil hole and loosen drive screw. Remove coil stud and lock washer.

2. To separate coil from armature, remove nuts, lock washers, and screws connecting them.

(f) BELLOWS.—Remove coil and armature from the rest of the pump. Then disconnect pump base from bellows ring by removing screws and lock washers connecting them and remove the airseal and bellows gaskets between them.

c. MAINTENANCE REPAIR OR REPLACEMENT.

(1) MAINTENANCE REPAIR.

(a) GENERAL.—The pump needs no lubrication and is intended to operate for an indefinite period without attention.

(b) FILTER.—Clean parts thoroughly, clearing away gasket particles.

(c) VALVE ASSEMBLY.

1. Clean all parts.

2. Resurface valve seats with crocus cloth.

(d) BELLOWS.—Clean faces of pump base and bellows ring.

(2) REPLACEMENT.

(a) FILTER.

1. Insure airtight filter by using new gaskets.

2. Replace screen if damaged.

(b) VALVE ASSEMBLY.

1. Replace valves if warped or excessively worn.

2. Guard tightness of valve chambers by using new gaskets.

(c) UPPER CONTACT POINTS.

1. For proper operation these points should be replaced when burned or pitted.

2. To replace, remove screws, nuts and washer connecting armature to plate.

3. Insert new contact points.

(d) LOWER CONTACT POINTS.—To replace lower contact points, punch out two rivets behind them.

(e) ARMATURE.—Replace a weak or rusted armature. Tinkering with it is inadvisable.

(f) BELLOWS.

1. Replace both bellows and airseal gaskets.

2. Replace washers and screws between pump base and bellows ring.

3. Replace worn bellows.

d. ADJUSTMENTS.

(1) Check space between breaker spring and main armature body. (Should check .040 inch at point shown.)

(2) Align and assemble armature and coil.

(3) Assemble coil and armature to the bellows ring, using studs or the corresponding screws and lock washers.

(4) Press armature plate flat against coil head.

(5) Assemble drive screw into bellows stud until bellows can just be seen to start downward movement.

(6) After releasing armature, tighten lock nut, using ¼-inch magneto wrench.

(7) Insert drive spring, adjust pressure screw and nut.

e. TEST BEFORE INSTALLATION.

(1) Test with alcohol, not air.

(2) Remove pump cover.

(3) Place pump in rack, connect to battery and ground pump.

Note

If pump rack is not available, install pump on a stand. Be sure that supply and discharge lines lead to containers, the supply line to alcohol in the container. Connect wire from battery to terminal at right base of pump. Be sure another wire grounds pump.

HTTP://WWW.AVIADOGS.COM/

(4) Turn on current. (Pump will race noisily until it picks up fluid from container.)

(5) Align upper and lower contact points by bending the flexible bridge of the upper contact at the lower contact point.

WARNING

Never move lower contact points laterally, always the upper. Lower contacts may be adjusted vertically from armature by special contact point adjusting tool until best performance is reached.

(6) Tighten pressure adjusting screw (use longer spring in older pumps), adjusting for maximum pump pressure.

(7) Put on cover and retest electrical connections.

f. ASSEMBLY AND INSTALLATION.

(1) ASSEMBLY.

(a) LOWER CONTACT POINTS.—Reassemble with new points and 9/32-inch rivets. (For correct locating of lower contact points on the armature body or plate, use special, breaker spring fixture tool.)

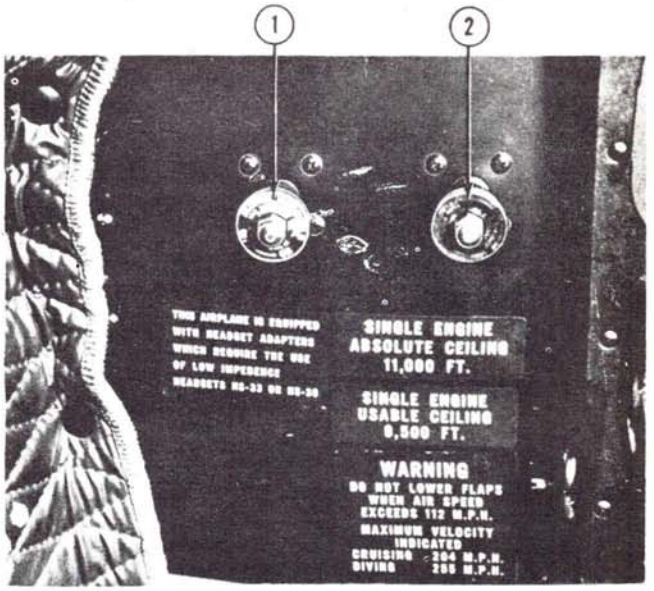

①
②
THIS AIRPLANE IS EQUIPPED WITH HEADSET ADAPTERS WHICH REQUIRE THE USE OF LOW IMPEDENCE HEADSETS HS-33 OR HS-38
SINGLE ENGINE ABSOLUTE CEILING 11,000 FT.
SINGLE ENGINE USABLE CEILING 8,500 FT.
WARNING
DO NOT LOWER FLAPS WHEN AIR SPEED EXCEEDS 112 M.P.H.
MAXIMUM VELOCITY INDICATED
CRUISING 204 M.P.H.
DIVING 255 M.P.H.

Figure 569—Windshield Anti-Icer System Fluid Control Knob

1. Windshield Anti-Icing Control
2. Windshield Wiper Control

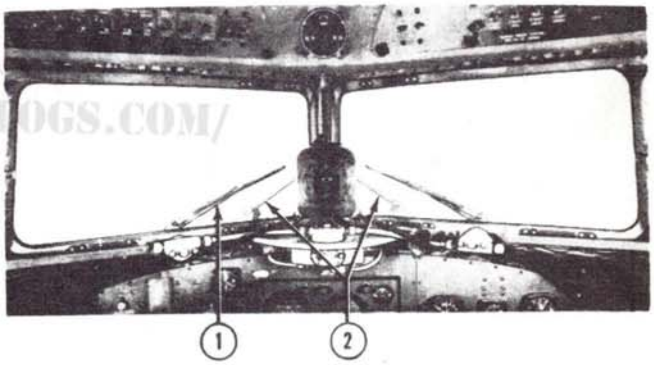


Figure 570—Windshield Anti-Icer System Horn Extension (Fluid Discharger Line)

1. Windshield Wiper
2. Horn Extension (Fluid Discharge Lines)

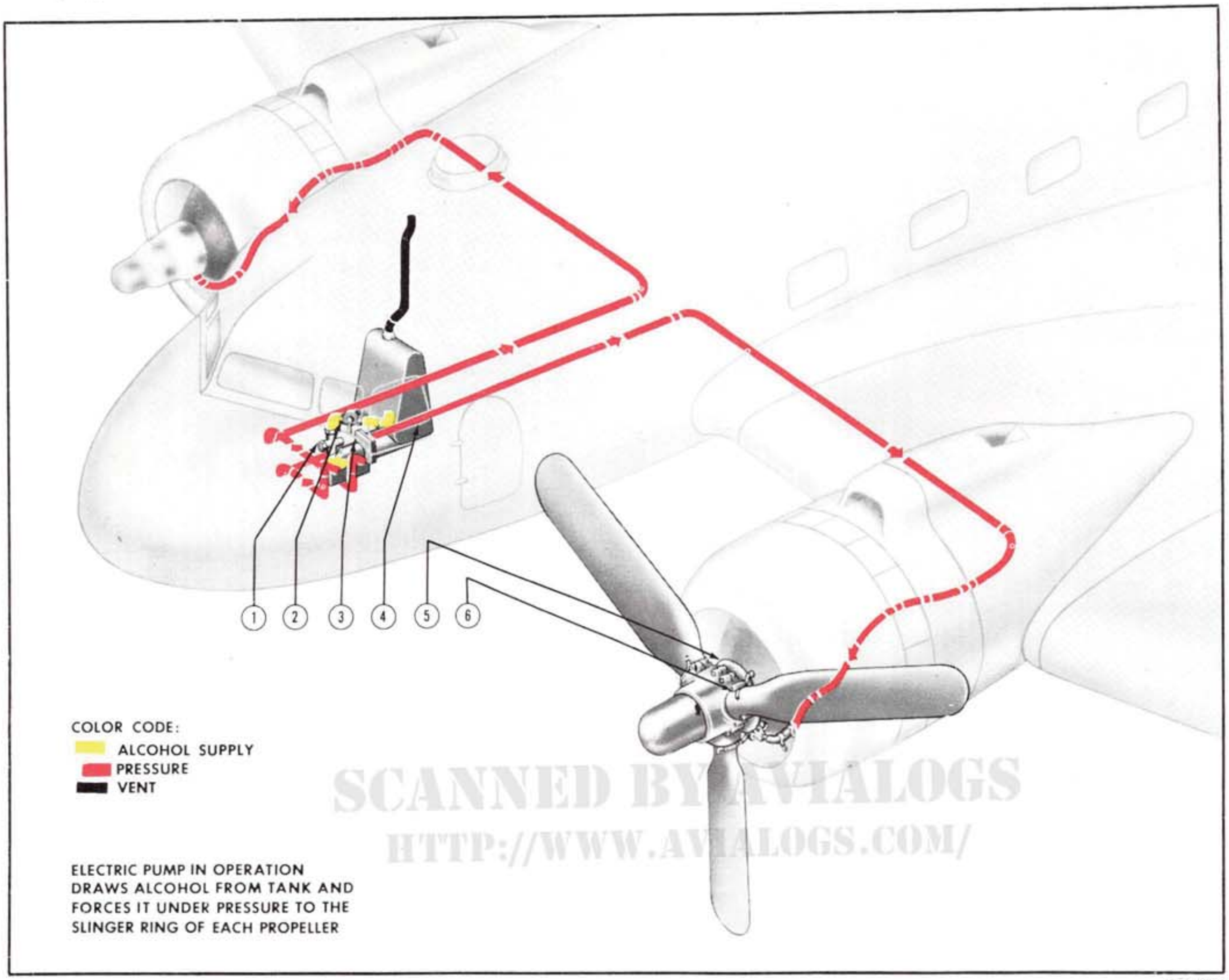
(b) MAGNET AND ARMATURE.

1. Magnet and armature must be precisely lined up. Place armature flat on top of magnet so that steel collar on lower contact points is free inside centering tool.

2. Hold units in position so as to reassemble armature and coil in correct relation, using armature screw, nut and lock washer. Do not disturb this relation.

3. Reverse procedure of disassembly for other parts of pump.

(2) INSTALLATION.—Reverse removal procedure.



ELECTRIC PUMP IN OPERATION DRAWS ALCOHOL FROM TANK AND FORCES IT UNDER PRESSURE TO THE SLINGER RING OF EACH PROPELLER

Figure 571—Propeller Anti-Icer System

14,544

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
1	EA8-2393	Eclipse Filter (Strainer)	1
	AF895-1	Elbow	
2	715 FT-40	Parker Shut-Off Valve	1
3	744-6	Eclipse Pump	1
	100-3 (Weldon)	Weldon Pump (Alternate)	
4	5116834	Tank	1
5	53612-F	Slinger Ring	2
6	52745	Bracket Assembly	6

g. TEST AFTER INSTALLATION.—Check pump in operation for performance and leakage at fittings.

3. CONTROL NEEDLE VALVE.

a. DESCRIPTION.—This valve controls the fluid flow to the front windshields. When the right (inboard) knob (2, figure 569) in front of the pilot on the instrument panel is turned clockwise, it withdraws the screw, to which the knob is attached and with which it turns, from the opening between the two ports of the valve. The more the screw withdraws, the wider the opening becomes for the passage of fluid, and the more fluid passes through the valve. A steel valve without a restrictor, it is supported by a metal plate just back of the instrument panel. The plate is held by four screws penetrating the panel.

Note

The location of the valve has been changed from in front of the pilot on the instrument

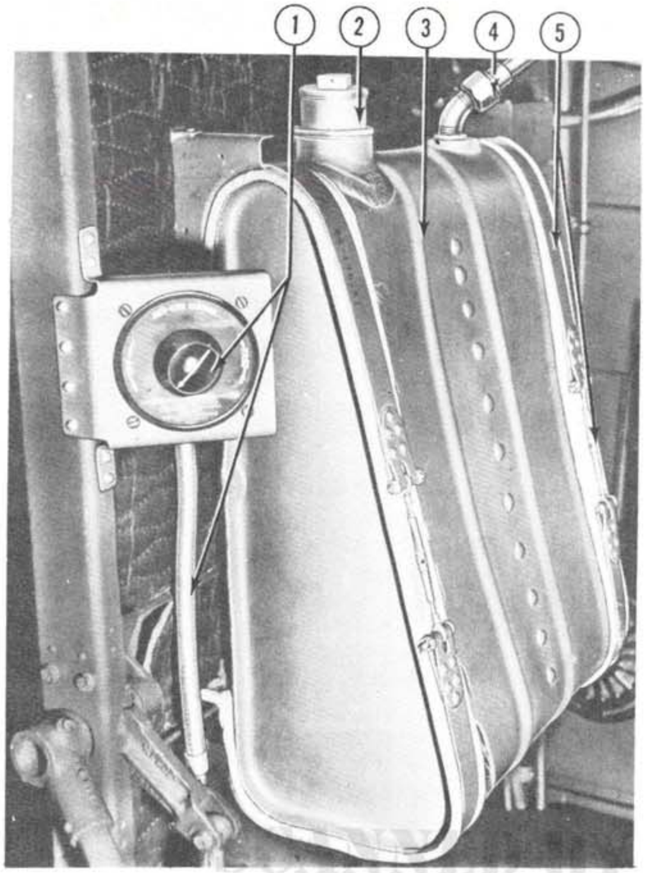


Figure 572—Propeller Anti-Icer System Fluid Supply Tank and Rheostat

1. Rheostat and Electrical Connection
2. Filler Neck and Cap
3. Tank
4. Vent Line
5. Supporting Strap and Turnbuckles

panel to in front of the copilot on the panel. The diagram (figure 562) shows the valve in the latest position.

b. REMOVAL AND DISASSEMBLY.

(1) REMOVAL.—To remove valve from panel, detach four screws holding plate and remove valve.

(2) DISASSEMBLY. — Remove screw to valve chamber and packing on screw.

c. MAINTENANCE REPAIR OR REPLACEMENT.

(1) Tighten loose packing.

(2) Replace damaged packing.

(3) Replace damaged valve if it cannot be lapped to satisfaction.

d. ASSEMBLY AND INSTALLATION.—Reverse removal and disassembly procedure.

4. LINES.

a. DESCRIPTION.—The lines to and from the valve are uniform and of aluminum. They are held by Adel clips to the right of the fuselage and to the instrument panel in front. The line from the valve pierces a hole, plugged with "dum-dum" putty and reinforced with a grommet, through the top middle of the fuselage. It joins the horn (bent tubing, 2, figure 570) between the windshields and is held by a clip below the juncture. The horn is held at either end to the fuselage by an angle, clip and spacer.

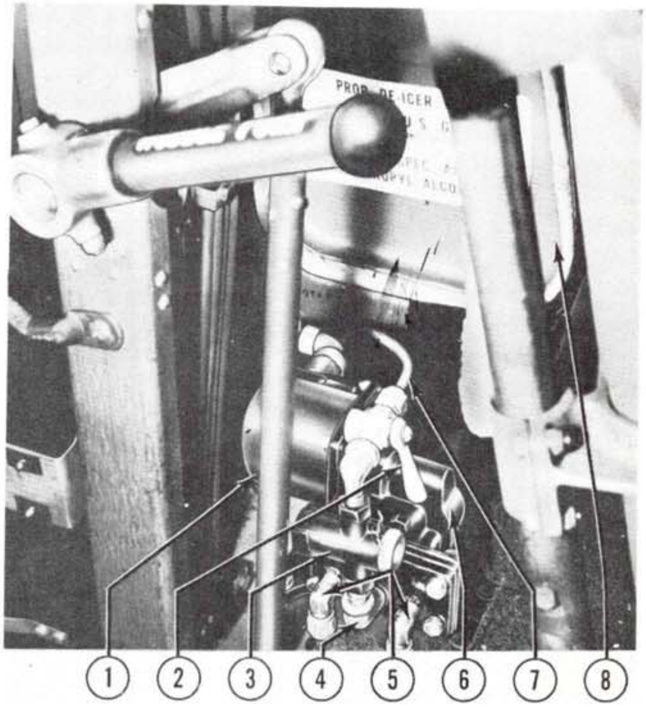


Figure 573—Propeller Anti-Icer System Fluid Supply Tank, Pump and Filter

1. Motor Housing
2. Parker Shut-Off Valve
3. Eclipse Filter
4. Inlet Port
5. Outlet Ports
6. Pump Housing
7. Supply Line
8. Supply Tank

b. REMOVAL AND DISASSEMBLY. — (For this and following procedures refer to paragraph 19.*c.*(1)*(d)4*.b.,c.,d., and e., this section.)

(2) PROPELLER ANTI-ICER SYSTEM. *(See figure 571.)*

(a) GENERAL.—The propeller anti-icer system is designed to prevent ice from forming on the propeller blades. Fluid is pumped from a supply tank (4, figure 571) through a shut-off valve (2, figure 571), filter (1, figure 571), and electric pump (3, figure 571) into a slinger ring (5, figure 571) on the propeller hub. Distributor lines (6, figure 571) from the ring supply each blade. The pump is turned "ON" or "OFF" by a switch on the pilot's electrical control panel. A rheostat (1, figure 572) to the right of the tank regulates the fluid flow by controlling the speed of the electric motor. (Refer to paragraph 14.*l*.(2), this section.)

(b) SUPPLY TANK. *(See figures 572 and 573.)*

1. DESCRIPTION.—The 4.2 U. S. (3.5 Imperial) gallons dural tank is supported by metal straps riveted to four brackets riveted to the front of the bulkhead directly aft of the pilot. On top are a filler neck (2, figure 572) and vent line (4, figure 572) extending through the top of the bulkhead and fuselage. On the bottom is the drain connection to the supply line (7, figure 573).

CAUTION

Use ONLY isopropyl alcohol, Specification No. AN-F-13, in the tank.

2. REMOVAL.

a. Disconnect vent line from top and fluid flow line from bottom of tank.

b. Loosen turnbuckles on straps and remove tank.

CAUTION

Remove tank before going into combat.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Refer to paragraph 19.*c.*(1)*(b)3.*,*4.*,*5.* and *6.*, this section for this and following procedures.

(c) ELECTRIC PUMP.

(See 1 and 6, figure 573 and figure 574.)

1. DESCRIPTION. — Beneath the tank and bolted to the floor is the type 744 Eclipse dual diaphragm pump.

Note

On some airplanes, the Weldon No. 101 pump and filter are used. There is so little difference in the operation, maintenance, etc, of this pump and filter from the Eclipse products that no detailed explanation is necessary.

The pump contains three ports at the lower side: an inlet port (1/8 inch) connected to the filter; and two outlet ports (1/8 inch), each connected to a discharge line on either side of the inlet port. On the upper side is an electrical connection for the line to the rheostat (see paragraph 14.*l.*(2), this section). The pump has an output of from 2 to 12 U. S. (1.7 to 10 Imperial) quarts per hour at a pressure of 15 to 20 psi. Its rated suction is 3 inches Hg. and maximum suction, 8 inches Hg. It consists of a two-pole, series wound motor, reduction gearing, and pump assembly. The explosion-proof, sealed motor drives the pump section through a 40:1 worm and wheel reduction. The worm wheel shaft drives the center gear of the pump through an Oldham-type coupling. The center or drive gear of the pump drives the outer gears which float in the center gear plate. Fluid is introduced to the inlet port and led to the suction side of the floating pump gears. The gears build up the necessary pressure to transmit the fluid to the slinger rings.

Note

This pump is similar in construction to the Adel pump in the carburetor anti-icer system (figure 578), except that the Adel pump has a direct drive.

No lubrication is required except for bearings. Lubricate these with grease, Specification No. AN-G-15.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect electric line to rheostat.

(2) Disconnect fluid outlet lines.

(3) Disconnect line to shut-off valve.

(4) Disconnect four bolts attaching pump base to floor. Remove pump.

(5) Disconnect shut-off valve and filter from inlet port.

b. DISASSEMBLY.

(1) Separate the pump and motor assemblies by removing three Allen socket head screws connecting them.

(2) Remove the brush cover screws and the brush adjusting screws, and pull out springs and brushes with a pair of tweezers.

Note

A more complete disassembly should be performed at depots only.

3. ADJUSTMENTS.—No adjustments are required except an occasional take-up on the brushes.

4. MAINTENANCE REPAIR OR REPLACEMENT.

a. Replace brushes worn to a length of 5/16 inch or less.

b. If commutator is dirty or requires reseating, mount armature in lathe and smooth up.

c. Replace damaged gaskets and seals.

d. Replace defective armature, mounting plate, ball bearings, cartridge, or pump housing.

e. Clean up surfaces of motor mounting plate.

5. TEST BEFORE INSTALLATION. — Put pump on bench. Make electrical and fluid connections. Start motor and check for pressure, capacity, and electrical input.

6. ASSEMBLY AND INSTALLATION. — Reverse removal and disassembly procedure.

Note

All parts must be free of foreign matter. Assemble pumping assembly parts wet with kerosene or alcohol.

7. TEST AFTER INSTALLATION.

a. Connect pump in system.

b. Prime pump.

Note

To prime with electric motor running, back off the two inlet valves approximately three

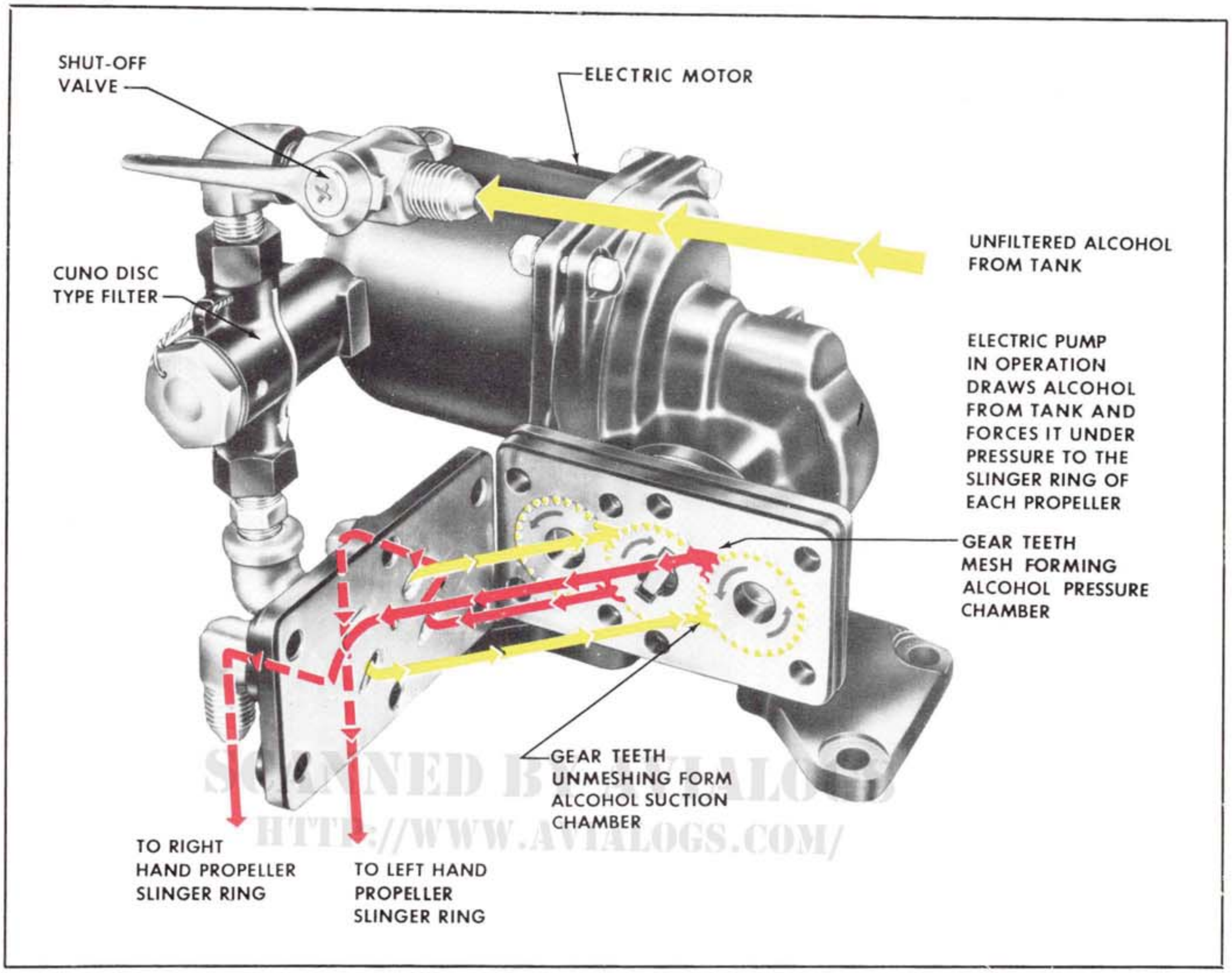

SHUT-OFF VALVE
ELECTRIC MOTOR
UNFILTERED ALCOHOL FROM TANK
CUNO DISC TYPE FILTER
ELECTRIC PUMP IN OPERATION DRAWS ALCOHOL FROM TANK AND FORCES IT UNDER PRESSURE TO THE SLINGER RING OF EACH PROPELLER
GEAR TEETH MESH FORMING ALCOHOL PRESSURE CHAMBER
GEAR TEETH UNMESHING FORM ALCOHOL SUCTION CHAMBER
TO RIGHT HAND PROPELLER SLINGER RING
TO LEFT HAND PROPELLER SLINGER RING

Figure 574—Propeller Anti-Icer System Pump (Showing Operation)

turns. Let pump run until all air is expelled from system and steady flow of fluid is obtained. Tighten valve plugs.

c. Check for performance and leakage.

8. MAJOR OVERHAUL.—This will be performed at depots only.

(d) FLUID FILTER.

(See figure 574 and 3, figure 573.)

1. DESCRIPTION.—The Eclipse dural multiple-disc filter is connected at the outlet port to the inlet port of the pump and at the inlet port to an elbow connecting the shut-off valve. The fluid flows from the inlet port through an inlet opening over multiple, brass discs in the base of the filter. The thin discs are held compactly, face to face, by a brass screw extending through their centers, throughout the length of the base. At the lower end of the base are the outlet opening and a threaded plug with a hole aligned to the outlet opening. The fluid sprays over the edges of the discs, leaving its deposit, and filters toward the cores. Tiny aligned holes through the discs carry the fluid through the outlet opening, outlet port, and into the pump.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect line from shut-off valve.

(2) Unscrew valve and elbow from inlet port of filter.

(3) Unscrew outlet port from pump and remove filter.

b. DISASSEMBLY.

(1) Unscrew plug from filter base end.

(2) Release nut at opposite, filter base end to release screw.

(3) Remove screw and discs.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Remove discs and clean with gasoline.

b. Clean filter base assembly (filter bowl) by blowing out passageway with air.

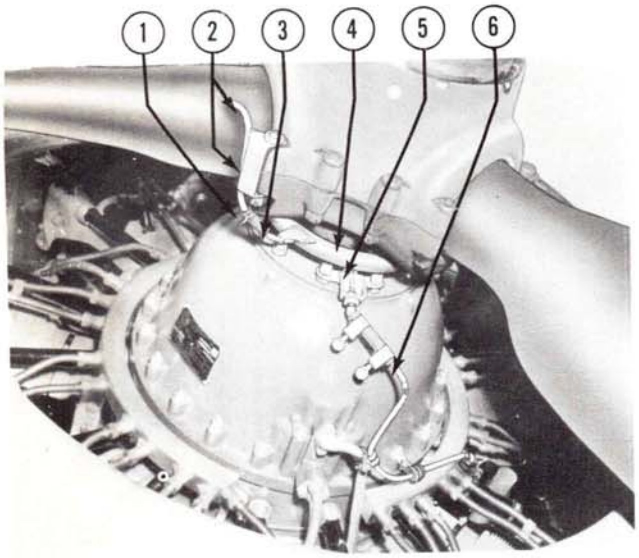


Figure 575—Propeller Anti-Icer Slinger Ring

1. Hose
2. Bracket Assembly and Distributor Line
3. Slinger Ring Line
4. Slinger Ring
5. Spout
6. Supply Line

c. Replace any part with bad cracks or torn threads.

d. Replace gasket at assembly regardless of condition.

4. ADJUSTMENTS. — Tighten plug to tighten surface bearing of discs and give better performance.

5. ASSEMBLY AND INSTALLATION. — Reverse removal and disassembly procedure.

6. TEST AFTER INSTALLATION.— With pump running, note leakage at fittings and performance.

(e) SHUT-OFF VALVE.
(See figure 574 and 2, figure 573.)

1. DESCRIPTION.—The valve, between the tank and filter, cuts off the supply of fluid from the tank to the pump in order that the pump or filter may be removed for repair etc, without draining the tank. It is a hand controlled, Parker plug valve. (For a more detailed description, disassembly etc, refer to paragraph 19.*c.1-7,* this section and figure 564.)

2. REMOVAL.—Disconnect line at entrance port and unscrew valves from elbow.

(f) LINES.

1. DESCRIPTION.— From the pump, two aluminum lines extend beneath the copilot's floor to the fuselage tunnel and aft to the wing tunnel where they separate. One continues along the right wing tunnel to the right nacelle; the other to the left nacelle. Each continues along the inboard side of the nacelle, through the fire wall and engine, to the slinger ring.

2. REMOVAL AND DISASSEMBLY.— Remove by disconnecting lines at connections and tab all parts to insure correct reassembly. Also remove Adel attaching clips.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. MAINTENANCE REPAIR.— Use fine emery cloth to remove scratches.

b. REPLACEMENT.—If lines are cracked, badly bent or scratched, corroded, or improperly flared at the ends, particularly under the sleeves, replace them.

(g) SLINGER RING AND DISTRIBUTOR LINES. *(See figure 575.)*

1. DESCRIPTION.—The channel collector ring (4, figure 575) is screwed to the propeller hub. It receives the fluid from a spout (5, figure 575) clipped to the forward part of the engine nose section and welded to the end of the line. Three 2-inch metal lines (3, figure 575) are welded to the rim of the ring at equal distances. At the end of each metal line is a short hose (1, figure 575) connecting a second 6-inch metal line, which is the distributor line (2, figure 575) to the blade. The connecting hose is secured to the metal lines by wires. Separating the ends of the lines by the hose serves to give play to the lines and minimize vibration. Another function of the hose is to allow easy removal of the distributor line in case it becomes damaged. Otherwise, the ring would have to be removed, which would necessitate removing the propeller. The distributor line, welded to a heavy bracket (2, figure 575) on the top middle section of the hub, extends to the front of the propeller blade. As the slinger ring rotates with the hub, centrifugal force carries the fluid from the ring through each of the three lines and down each propeller blade.

Note

On some winterized airplanes, fluid feed shoes are installed on the propeller blades. The shoes consist of narrow strips of rubber cemented along the leading edge of the blades about two-thirds of the distance from hub to tip. The strips are grooved to facilitate fluid flow. The alcohol distributed over the blades lowers the freezing point of moisture coming in contact with the blades.

2. REMOVAL.

a. To remove distributor line, release wiring at either end of hose, unscrew hub bracket, and remove line with bracket welded to it. The distributor line and bracket are known as the bracket assembly.

Note

To install a new distributor line, it will be necessary to install a bracket assembly.

b. To remove collector ring, release three short metal lines from three hoses; then remove propeller and unscrew ring from hub.

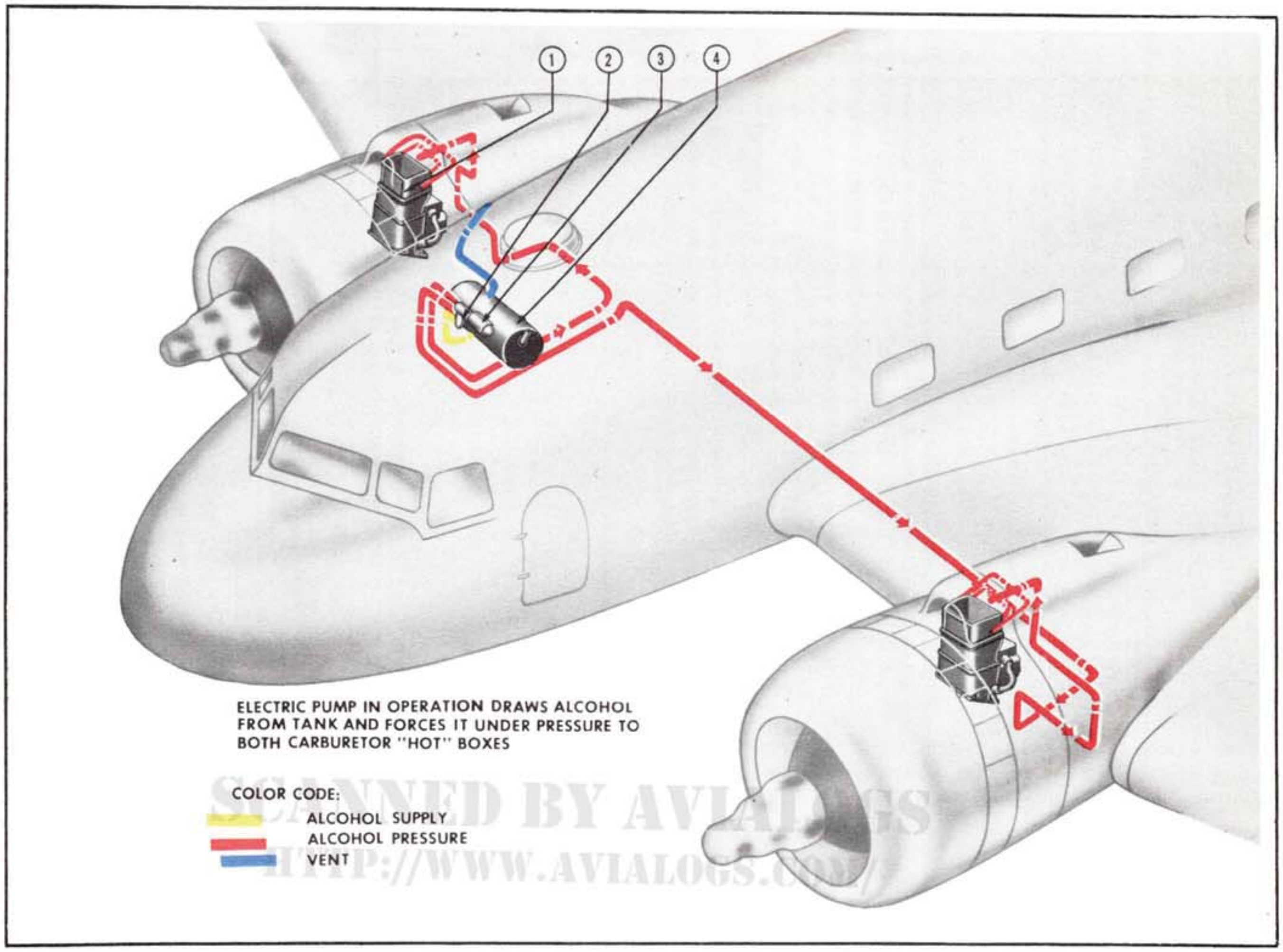

①
②
③
④
ELECTRIC PUMP IN OPERATION DRAWS ALCOHOL FROM TANK AND FORCES IT UNDER PRESSURE TO BOTH CARBURETOR "HOT" BOXES
COLOR CODE:
🟨 ALCOHOL SUPPLY
🟥 ALCOHOL PRESSURE
🟦 VENT

Figure 576—Carburetor Anti-Icer System

Name	*Part No.*	*No. Req Per Apl*
1. Hot Box	4202933	2
2. Adel Filter	A7979	1
3. Adel Pump	D-7818	1
Weldon Pump	101 (Alternate)	
4. Tank Assembly	5139830	1
Tank	8-001	1
Plug	AF909-16	1

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. MAINTENANCE REPAIR.—Small holes in ring and lines may be welded.

Note

Considerable leakage in the system has resulted from leaking slinger rings.

b. REPLACEMENT.

(1) Replace worn or frayed lines or hoses.

(2) Replace bent or corroded slinger ring, lines, or spout.

(3) CARBURETOR ANTI-ICER SYSTEM. *(See figure 576.)*

(a) GENERAL.—Due to the high relative humidity of the atmosphere, coupled with the drop in pressure (and resulting drop in temperature) at the throat of the venturi, ice may form in the throat of the carburetor even when the outside temperature is comparatively as high as 21° to 27°C (70° to 80°F).

Note

Relative humidity is the percent of water vapor in the air compared to the total amount the air will hold at a given temperature. Icing is possible only when the relative humidity is very high.

The carburetor anti-icer system consists of an electric pump (3, figure 576) forcing alcohol from a supply tank (4, figure 576) through a filter (2, figure 576), the pump, two identical check valves, and manifolds into the hot boxes (lower sections of the air

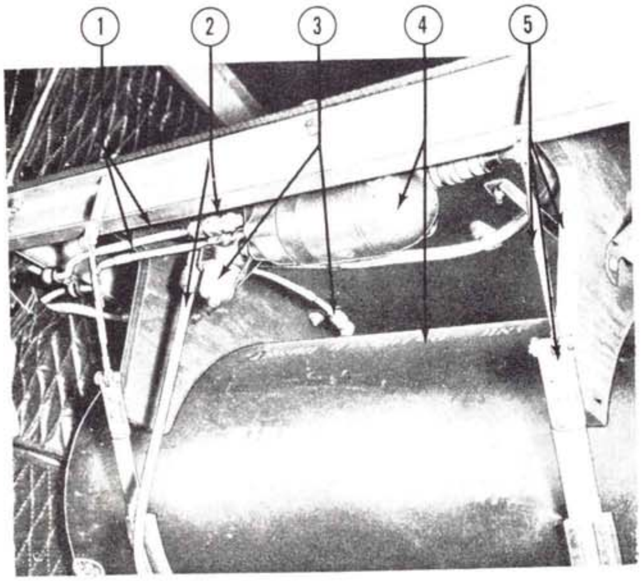


Figure 577—Carburetor Anti-Icer System Fluid Supply Tank, Pump, Filter and Check Valves

1. Outlet Lines
2. Check Valve and Inlet Line
3. Adel Filter and Tank Vent
4. Adel Pump and Tank
5. Strap, Turnbuckle, and Cradle

scoops attached to the adapter cases). At a constant pressure, the system consumes approximately 8 U. S. (6.7 Imperial) gallons per hour.

(b) SUPPLY TANK. *(See 4, figure 577.)*

1. DESCRIPTION.—The cylindrical, rubberized-fabric tank of 11 U. S. (9.2 Imperial) gallons capacity is suspended by metal straps (5, figure 577) from the dural frames of a plywood shelf in the lower aft section of the baggage compartment. The tank is designed to stand a pressure of 5 psi. From the top is a vent line (3, figure 577) extending through the top of the fuselage. From the bottom is the drain and supply line (2, figure 577) extending to the filter and pump. On the inboard end is the filler neck protruding into the companionway.

CAUTION

Use only isopropyl alcohol, Specification No. AN-F-13.

2. REMOVAL.

CAUTION

Remove tank before going into combat.

a. Disconnect vent and supply lines.

b. Loosen two turnbuckles, one supporting a strap at either end of the tank, and remove tank.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. MAINTENANCE REPAIR.— In emergencies for repairing a leaking or damaged tank, follow the procedure for repairing nonmetallic tanks in T. O. No. 01-40NC-3, section XIII, paragraph 2.*b.*

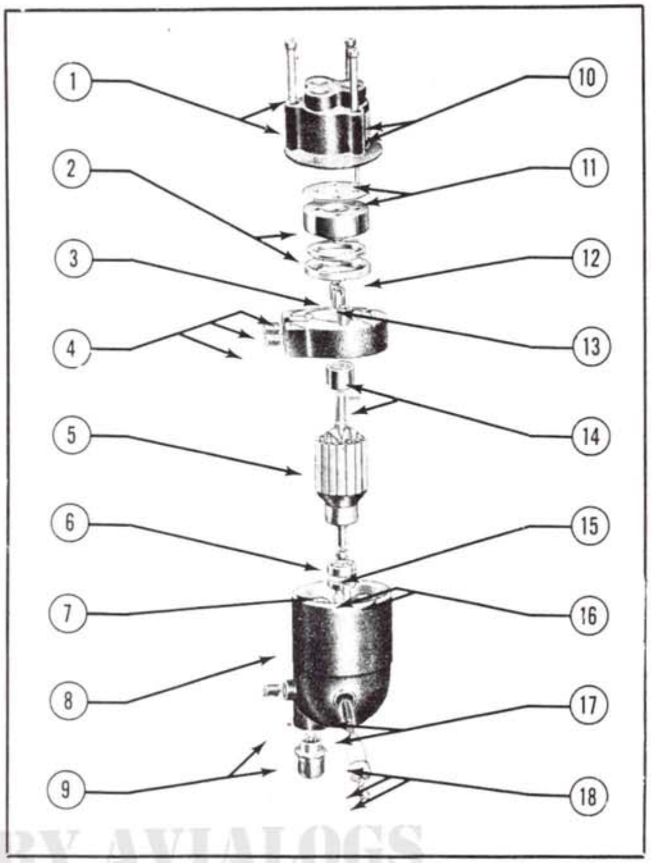


Figure 578—Carburetor Anti-Icer System Pump (Exploded View)

1. Pump Housing and Allen Head Cap Screw
2. Stator and Equalizer
3. Shell Nut
4. Insert Lockpins and Mounting Plate
5. Armature
6. Shaft Spacer
7. Bearing Spacer
8. Motor Housing
9. Electrical Connector and Brush Adjustment Screw
10. Drive Screw and Name Plate
11. Dowel and Gasket
12. Lock Ring
13. Coupling
14. Front Bearing and Pin
15. Rear Bearing
16. Stud and Field Coil and Lock Nut
17. Brush and Brush Spring
18. Brush Cover, Adjusting Screws, and Holder

b. REPLACEMENT.—Replace badly worn or leaking tanks.

4. INSTALLATION.— (Refer to paragraph 19.*c.*(1)*(b)5.,6.,* this section.)

(c) ELECTRIC PUMP.

1. DESCRIPTION.—The (J4.0-24D-1/8 P.T.) Adel, metering fluid pump is suspended above the tank from the plywood shelf by three screws. (See 4, figure 577.) At the inboard end is an electrical connection energized from an "ON," "OFF," and "MOM" switch on the copilot's electrical control panel. (Refer to para-

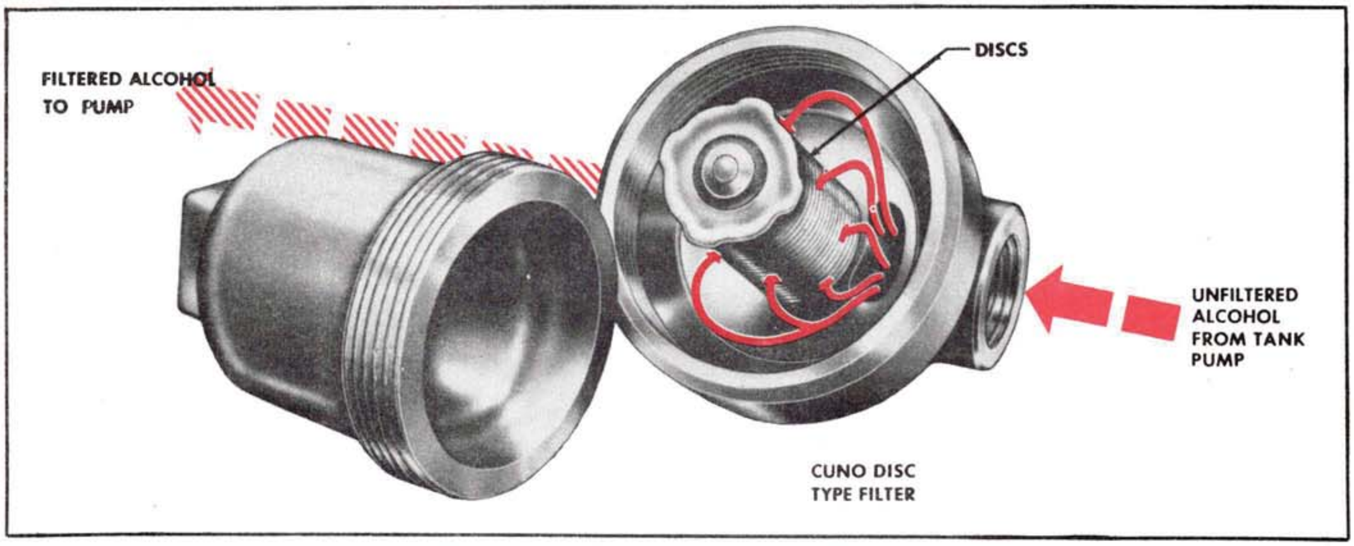


Figure 579—Carburetor Anti-Icer System Filter Fluid Flow

graph 14.*l.*(5), this section.) At the outboard end are two outlet ports and an inlet port. The pump assembly consists of a motor and a pump held together by three Allen socket head screws. The motor drives the pump through a simple universal coupling which rotates in an independent chamber between the motor and pump. (See figure 578 for complete breakdown of motor and pump assemblies.) A rotating assembly, consisting of a connected rotor and shaft, builds up, through a stator, pressure which draws the fluid from the inlet port through drilled passageways in the shaft, and discharges it through the two outlet ports. The pump output is 4 U. S. (3.3 Imperial) gallons per hour per port, or 8 U. S. (6.7 Imperial) gallons per hour.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—To remove pump, remove three screws attaching it to plywood shelf and disconnect filter, check valves and electrical connection.

b. DISASSEMBLY.—For this and all following procedures, refer to paragraph 19.*c.*(2)*(c)2.*b. *(3)-(8),* this section.

(d) FLUID FILTER. *(See 2, figure 577.)*

1. DESCRIPTION.—An Adel filter is screwed to the pump, inlet port. The filter (figure 579) consists of two parts: a dural cap, incorporating the inlet and outlet ports; and a cadmium-plated, brass bowl to collect sediment. The fluid is drawn through the inlet port, into a drilled passageway in the cap, and into the bowl which surrounds the multiple-disc type filtering element. It is then drawn through the element and outlet port by the suction of the pump. The element is provided with large enough spaces between the laminations to permit passage of the required amount of fluid, but small enough to prevent small particles from entering the pump.

Note

This filter is similar to the filter attached to the propeller anti-icing pump. (Refer to paragraph 19. *c.*(2)*(d),* this section.)

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect supply line from inlet port.

(2) Unscrew outlet port from pump inlet port.

b. DISASSEMBLY.

(1) Insert ⅛-inch diameter steel rod in hole through the bottom of bowl and unscrew bowl from cap. (It may be necessary to clamp cap in a vise to secure necessary leverage.)

(2) Unscrew filter element and remove cap. (No wrench is necessary for removal.)

(3) Remove seal.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Clean all parts thoroughly.

b. Blow out cap passageways with air.

c. Hold filter element in one hand and blow laminations apart with air. If necessary, scrub with gasoline to remove caked sediment.

d. If the bowl is cracked or its threads torn, replace it.

e. Replace cap with bad cracks or torn threads.

f. Replace gasket at reassembly, regardless of condition.

g. Replace damaged filter element.

4. ADJUSTMENTS.—If filter leaks, tighten all connections.

5. ASSEMBLY AND INSTALLATION.—Reverse removal and disassembly procedure.

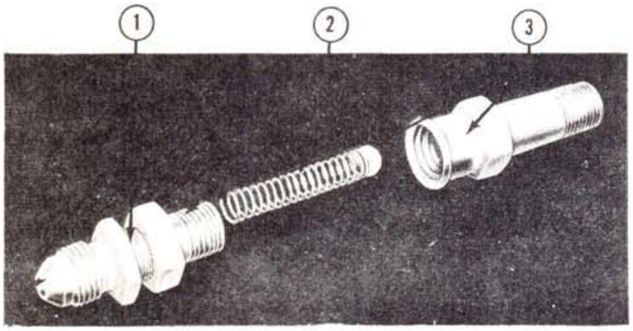


Figure 580—Carburetor Anti-Icer System Check Valve (Exploded View)

1. Outlet Port and Lock Nut
2. Regulator Nut, Cap, and Spring
3. Ball, Barrel, and Inlet Port

WARNING

Do not use wrench for tightening the element in place. Be sure cap and bowl are tightly screwed together.

6. TEST AFTER INSTALLATION.—Connect filter to system and check for leaks, restrictions, etc.

(e) CHECK VALVES. *(See 2, figure 577.)*

1. DESCRIPTION.—A check valve, screwed into each outlet port of the pump, checks the fluid from flowing into the discharge line when the pump is inactive.

Note

Unless the fluid were checked, the head of fluid in the long discharge line to the carburetor would syphon the fluid from the tank and drain the system. Since the head pressure (pump not operating) never exceeds 1-½ psi, the valve will always hold it. Since the pump pressure always exceeds 1-½ psi, the valve is open when the pump is operating.

The steel valve consists of a cap (2, figure 580) screwed into a barrel (3, figure 580). The barrel contains the inlet port and a ball and spring. The cap contains a lock nut (1, figure 580) to maintain spring tension, a regulator nut to adjust spring tension, and the outlet port. When fluid is pumped into the barrel, it unseats the spring-loaded valve, flows through the barrel, and out the outlet port of the cap.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect discharge line from outlet port.

(2) Unscrew inlet port from pump outlet port.

b. DISASSEMBLY.

(1) Unscrew cap from barrel.

(2) Remove spring, ball, and rubber washer sealed to lock nut.

3. MAINTENANCE.

a. If valve leaks, clean out dirt particles from ball and seat.

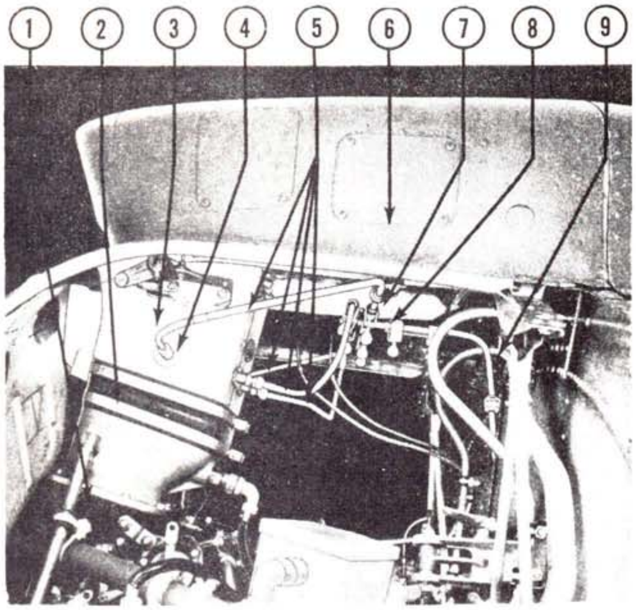


Figure 581—Carburetor Anti-Icer System Manifold and Carburetor Hot Box

1. Carburetor
2. Carburetor Adapter
3. Hot Box
4. Nozzle, Flange and Nipple
5. Distributor Lines
6. Air Induction Scoop
7. Hose
8. Manifold
9. Supply Line

b. Slightly untrue valve seat may be lapped.

(f) LINES.

1. DESCRIPTION.—All the lines are aluminum except the line to the manifold and the four lines from the manifold to the nipples of the hot box. These are copper to better resist the heat and vibration in that section. The lines extend along the lower right of the fuselage (inside) and separate at the wing tunnel. Each line continues along the wing tunnel to the nacelle and along the inboard side of the nacelle through the fire wall. On the right nacelle, the line crosses the fire wall, extends upward, then crosses back to the manifold in front of the hot box which is above adapter case and carburetor. On the left nacelle, the line extends up the fire wall and forward to the manifold.

2. REMOVAL.—Follow procedure in paragraph 19.*c.*(2)*(f)2.,3.*, this section for this and following procedures.

(g) MANIFOLD AND DISTRIBUTOR LINES. *(See figure 581.)*

1. DESCRIPTION.—The manifold (8, figure 581) distributes the fluid from the supply line (9, figure 581) to the distributor lines (5, figure 581). It is held by a clamp suspended from the bottom of the air scoop (6, figure 581). The manifold consists of a 4-inch aluminum tapered line. Two shorter aluminum lines extend from either side of the forward and larger end which is welded shut. The manifold has the appearance of a double T.

Five hoses (7, figure 581) join the five open terminals of the manifold. One hose connects the open end to the copper supply line (9, figure 581) and four hoses connect the four side manifold lines to the four copper distributor lines. Each distributor line penetrates a brass nipple screwed into a brass flange (4, figure 581) which is riveted to the hot box (3, figure 581). The flange also encircles the fluid outlet hole through the wall of the hot box. The nipple incorporates a fine hole or nozzle through which the fluid sprays into the hot box. There are four such nozzles and flanges; one on each side of the hot box, and two on the rear. Sprayed into the hot box, the fluid settles through the adapter case (2, figure 581) into the carburetor.

2. REMOVAL.

a. Remove attaching clamp.

b. Remove wires and hoses connecting manifold lines to distributor lines.

c. Remove manifold and disconnect distributor line from nipple.

d. Unscrew nipple from flange.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Follow procedure in paragraph 19.*c.*(2)*(f)*3., this section.

(4) WINDSHIELD ANTI-ICER SYSTEM. (Late C-47B Airplanes.)

(a) GENERAL. *(See figure 561A.)*—The windshield anti-icer system furnishes alcohol to the outside of the windshields to prevent ice from forming and to maintain clear visibility. This system is comprised of a tank, pump and filter (common to both the windshield anti-icer and carburetor systems). Alcohol is pumped from the tank, through the pump, and filter onto the front and side windshields.

(b) SUPPLY TANK. *(See figure 581A.)*

1. DESCRIPTION.—A 11.5 US (9.6 Imperial) gallon aluminum-alloy tank is installed on the right side of the middle wing section under the wing fillet. Metal straps, around the triangular shaped tank, are bolted to keep the tank rigid on its bracket. Strips of Adelite protect the tank from scraping the metal brackets. On the top right side of the tank is a vent and a filler neck. The filler neck extends through the fillet. The vent has its outlet in the bottom side of the wing. To the rear and underside of the tank are the drain and the manually operated valve allowing entrance of the alcohol from the tank into the supply lines going to both the windshield and the carburetor anti-icer systems.

CAUTION

> Fill the tank with isopropyl alcohol specification No. AN-F-13, only.

2. REMOVAL.

a. Disconnect vent line at the front right side of the tank and the fluid flow line at the lower back side.

b. Release nuts from ends of metal fasteners attached to ends of straps.

c. Remove the straps and lift tank from its bracket.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. MAINTENANCE.—Repair small holes by welding after emptying tank.

WARNING

> Alcohol is inflammable. Take necessary precautions.

b. REPLACEMENT.—Replace badly damaged tanks.

4. TEST BEFORE INSTALLATION.—Test by applying an air pressure of three pounds per square inch. A soap solution applied to the surface will bubble in case of leakage.

5. INSTALLATION.—The installation procedure is substantially the same as the removal procedure above.

(c) SHUT-OFF VALVE. *(See 1, figure 581A.)*

1. DESCRIPTION.—In the filter assembly aft of the tank is a hand controlled small plug valve. It turns the fluid supply from the tank to the supply line ON and OFF. When the control handle is moved it turns a tapered plug aligning a hole with the hole to the parts of the valve. This allows the fluid held at the inlet port to flow through the plug and outlet port of the valve. The body of the valve contains the inlet and outlet ports; and, at right angles to them, the sleeve, or seat, within which the plug turns. Within the hollow plug is a spring to hold the plug snug against the seat at the handle end. At the handle end of the plug is a hexagonal nut which fits securely within the head of the handle. The plug is tapered for tighter and more uniform bearing surface against the seat. At the opposite end of the plug a cap screws into the body.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.

(1) Disconnect inlet port from tubing.

(2) Disconnect the valve from the mounting elbow.

b. DISASSEMBLY.

(1) Remove screw from the handle and handle from hexagonal nut.

(2) Unscrew cap from body and remove spring and plug.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Tap slightly rough plug or sleeve.

b. File uneven or worn threads.

c. Replace valve if plug or sleeve cannot be properly lapped.

d. Replace loose or worn spring.

e. Replace worn or twisted washer.

f. Replace valve if units have torn threads, or are otherwise badly damaged.

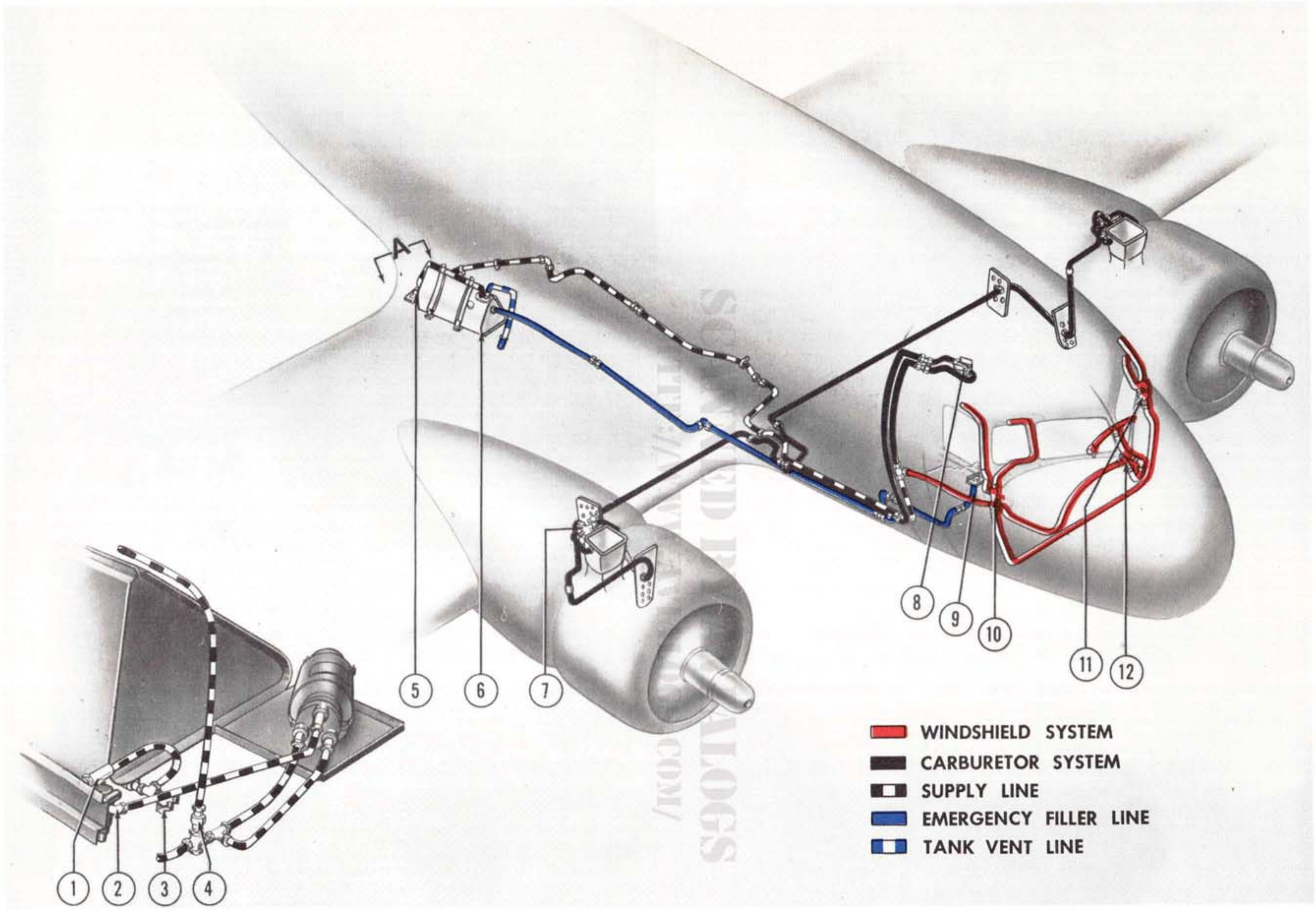

A
1
2
3
4
5
6
7
8
9
10
11
12
🟥 WINDSHIELD SYSTEM
■ CARBURETOR SYSTEM
▣ SUPPLY LINE
🟦 EMERGENCY FILLER LINE
▣ TANK VENT LINE

Figure 581A—Windshield and Carburetor Anti-Icer System

1. Parker Valve (715-FT-4D)
2. Weldon Filter (100800)
3. Whittaker Cock Drain (W7600-2)
4. Adel By-pass Valve (A-8182-3)
5. Weldon Pump (400-7)
6. Tank Assembly (5188619)
7. Manifold Assembly (4141852)
8. Parker Valve (720-HT-6D)
9. Bracket (4188884)
10. Parker Plug Valve (702-GG-4D)
11. Parker Plug Valve (715-GT-4D
12. Acrotorque Valve (B12306)

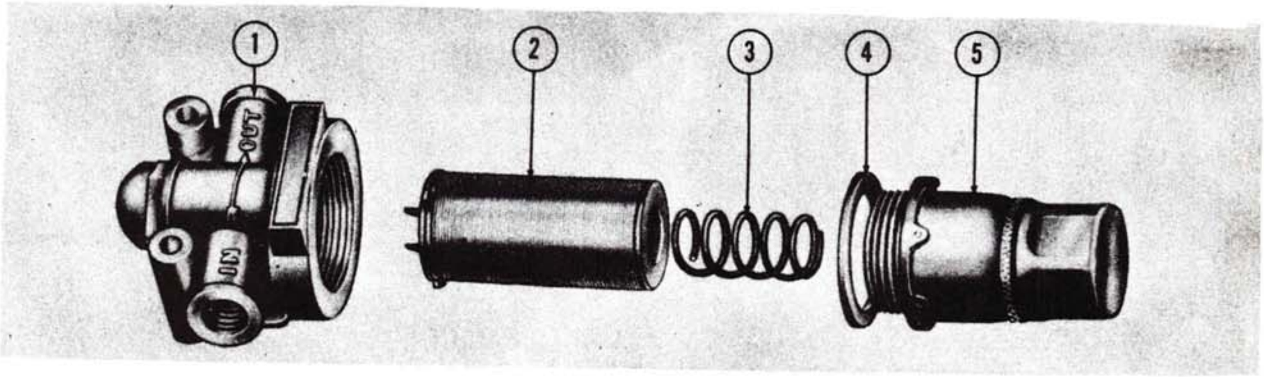


Figure 581B—Windshield and Carburetor Alcohol Anti-Icer System Filter

1. Filter Heads (With Pressure Relief) 2. Ceramic Filter 3. Spring 4. Gasket 5. Filter Bowl

4. ADJUSTMENTS.—If a valve is leaking slightly, pull out spring and tighten its tension against the plug at the handle end.

5. TEST BEFORE INSTALLATION.—With valve in water, apply air to the inlet part and check for bubbles.

6. ASSEMBLY AND INSTALLATION.

a. Replace the valve, washer and spring into the plug.

b. Insert plug and spring into body.

c. Screw cap on body.

d. Replace the handle on body.

(d) FLUID FILTER. *(See figure 581B.)*

1. DESCRIPTION.—A Skinner filter is located in the line between the tank and the inlet port of the pump. It is mounted on a bracket to the fuselage. The filter consists of four parts: a metal cap incorporating the inlet and outlet ports, a dural bowl to collect sediment, a filter, and a filter spring. The fluid is drawn through the inlet port, into a drilled passageway in the cap and into the bowl which surrounds the filter element. It is then drawn through the filter element and outlet port by the suction of the pump. The element is provided to permit passage of the required amount of fluid, but small enough to prevent small particles from entering the pump. This filter is common to both the windshield and carburetor anti-icer systems.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—Disconnect supply line from the inlet and outlet port.

b. DISASSEMBLY.—Firmly grip the metal cap and with a wrench fitted on the bowl unscrew the bowl from the cap. (It may be necessary to clamp cap in a vise to secure necessary leverage.) Remove filter element and spring.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Clean all parts thoroughly.

b. Blow out cap passageway with air.

c. Scrub the filter element with gasoline to remove sediment.

d. If bowl is cracked or threads torn replace it.

e. Replace cap with bad cracks or torn threads.

f. Replace gasket at reassembly, regardless of condition.

g. Replace damaged filter element.

4. ADJUSTMENTS.—If filter leaks, tighten all connections.

5. ASSEMBLY AND INSTALLATION.

a. Insert filter and spring in bowl and screw the bowl to the cap. Be sure cap is screwed tightly to the bowl.

b. Insert and connect the inlet and outlet ports to the line between the tank and the inlet port of the pump.

6. TEST AFTER INSTALLATION.—Connect filter to system and check for leaks or restrictions.

(e) ELECTRIC PUMP. *(See figure 581C.)*

1. DESCRIPTION.—The Weldon No. 400-7 pump is a direct driven, positive displacement, cam type fluid metering pump. The design of the pump has two outlet ports and produces a result equivalent to two separate pumps. The pump is located aft of the tank on a bracket attached to the wing. At the outboard end is an electrical connection energized from an "ON," "OFF" and "MOM" switch on the copilot's electrical control panel which controls both the carburetor and windshield anti-icer systems. At the inboard end are two outlet ports and one inlet port. The pump assembly consists of a motor and a pump held together by four screws. (See figure 581C.) A rotating assembly, consisting of a connected motor and shaft,

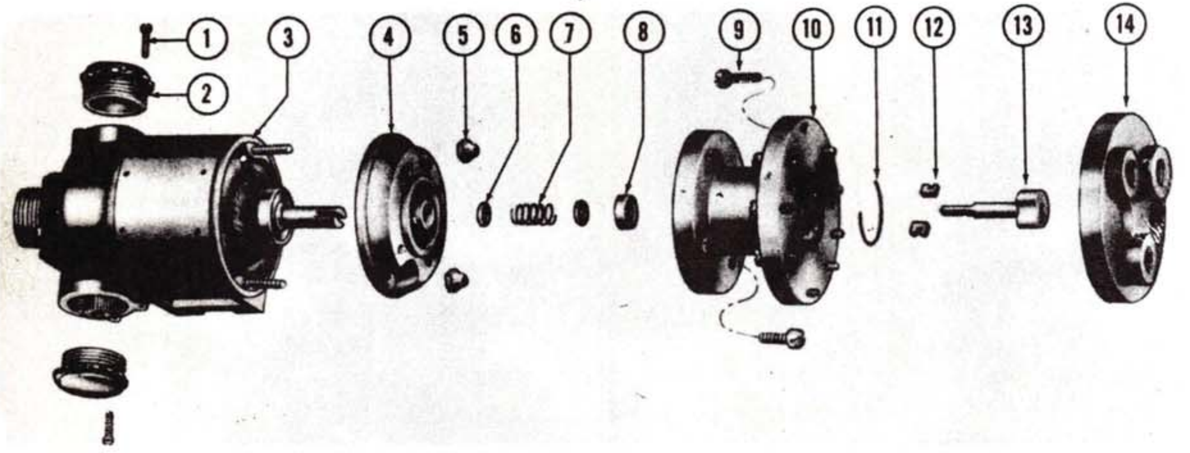


Figure 581C—Windshield and Carburetor Alcohol Anti-Icer System Pump

1. Bushing Cap
2. Bushing Screw
3. Motor with Armature
4. Motor Bearing Housing
5. Housing Nut
6. Washer
7. Spring (Seal Retaining)
8. Drive Seal
9. Pump Housing Bolt
10. Pump Housing
11. Lock Ring
12. Blades
13. Pump Cam
14. Housing Cap

builds up pressure which draws the fluid from the inlet port through drilled passageways in the shaft and discharges it through the two outlet ports.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—To remove the pump, remove the screws attaching the pump on a plate to the bracket and disconnect the inlet and outlet port lines together with the electrical connections.

b. DISASSEMBLY.

(1) Separate the pump and motor assemblies by removing the four connecting screws.

(2) Remove the brush cover screws and the brush adjusting screws, and pull out springs and brushes with a pair of tweezers.

Note

A more complete disassembly should be performed at depots only.

3. ADJUSTMENTS.—No adjustments are required except an occasional take up on the brushes.

4. MAINTENANCE REPAIR OR REPLACEMENT.

a. Replace worn brushes.

b. If commutator is dirty or requires resetting, mount armature in lathe and smooth up.

c. Replace defective armature, mounting plate, ball bearing, cartridge or pump housing.

d. Replace damaged gaskets and seals.

e. Clean up surfaces of motor mounting plate.

5. TEST BEFORE INSTALLATION. — Put pump on bench. Make electrical and fluid connections. Start motor and check for pressure, capacity and electrical output.

6. ASSEMBLY AND INSTALLATION.

a. Insert brushes and springs and tighten the brush adjusting and cover screws.

b. Fasten together the pump and motor by tightening the four attaching screws.

c. Make the electrical connections.

d. Connect the lines to the inlet and outlet ports.

e. Fasten pump and motor assembly to bracket.

(f) DRAIN COCK.

1. DESCRIPTION.—On the tank feed line, just aft of the tank is located a tank drain cock. It consists of a brass lock plug so designed that it can be locked into place and does not require lockwire. The plug screws into a tee in the main line from the tank.

2. REMOVAL.—Unscrew plug from line.

3. MAINTENANCE REPAIR OR REPLACEMENT.—Replace plug having torn or worn threads or otherwise damaged.

(g) LINES.

1. DESCRIPTION.—All lines are aluminum and carry a white and yellow banding line.

CAUTION

The usual precaution in handling aluminum lines must be taken.

2. REMOVAL.—Disconnect lines at connections.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Remove slight scratches with fine emery cloth. Polish them with oiled crocus cloth.

b. Replace badly bent or cracked lines.

c. Small holes may be welded.

d. If perforations in the windshield tubing become clogged, snip off the pinched end of the line and blow it out. Then pinch end shut with a hand vise or heavy pliers.

4. TEST AFTER INSTALLATION.—Test fittings and lines for leakage.

(b) CONTROL NEEDLE VALVE.

1. DESCRIPTION.—This valve controls the fluid flow to the windshield. When the center knob in the V of the windshield above the instrument panel is turned clockwise, it withdraws the screw, to which the knob is attached and with which it turns, from the opening between the two ports of the valve. The more the screw withdraws, the wider the opening becomes for the passage of fluid, and more fluid passes through the valve. A steel valve with a restrictor is supported by a metal plate just back of the instrument panel. The plate is held by four screws penetrating the panel.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—To remove valve from panel, detach from screws holding plate and remove valve.

b. DISASSEMBLY.—Remove screw to valve chamber and packing on screw.

3. MAINTENANCE REPAIR OR REPLACEMENT.

a. Tighten loose packing.

b. Replace damaged packing.

c. Replace damaged valve if it cannot be capped to satisfaction.

4. ASSEMBLY AND INSTALLATION.

a. Insert packing on screw and tighten screw on valve chamber.

b. Insert the four screws in plate and tighten to panel.

(b) RELIEF VALVE. *(See figure 581A.)*

1. DESCRIPTION.—A relief valve, in the relief pressure line above the drain plug, allows the excess fluid to flow back into the tank if an excessive pressure is prevalent.

Note

Unless the fluid was by-passed through this relief valve when, for instance, only the front windshield anti-icer needed fluid, the flow would be too great and would cause pump restriction. The relief valve and relief pressure line eliminates the possibility of this condition occurring.

2. REMOVAL AND DISASSEMBLY.

a. REMOVAL.—Disconnect the pressure relief valve from the pressure relief line.

b. DISASSEMBLY.

(1) Unscrew cap from barrel.

(2) Remove spring, ball and rubber washer sealed to lock nut.

3. MAINTENANCE.

a. If valve leaks, clean out dirt particles from ball and seat.

b. Slightly untrue valve may be lapped.

(5) CARBURETOR ANTI-ICER SYSTEM. *(Late C-47B Airplanes.)*

(a) GENERAL.—Due to high relative humidity of the atmosphere, coupled with the drop in pressure (and resulting drop in temperature) at the throat of the venturi, ice may form in the throat of the carburetor even when the outside temperature is as high as 21 degrees C to 27 degrees C (70 degrees F to 80 degrees F).

The carburetor anti-icer system electrical pump forces alcohol from the main tank, through the filter, to the electrical pump and then to the shut-off valve. From the shut-off valve, the lines divide and go to the manifold through the spray nozzles to the carburetors. (See figure 581A.)

(b) LINES.

1. DESCRIPTION.—The lines extend along the lower right of the fuselage and separate at the wing tunnel. Each line continues along the wing tunnel to the nacelle and along the inboard side of the nacelle through the firewall. On the right nacelle, the line crosses the firewall, extends upward, then forward to the manifold. On the left nacelle, the line extends up the firewall and forward to the manifold.

2. REMOVAL.—Follow procedure in paragraph 19*c*(2)*(g)2*.

(c) MANIFOLD AND DISTRIBUTOR LINES. *(See figure 581.)*

1. DESCRIPTION.—The manifold (8) distributes the fluid from the pressure line (9) to the distributor lines (5). It is held by a clamp suspended from the bottom of the air scoop cowling (6). The manifold consists of a four-inch aluminum tapered line. Two shorter aluminum lines extend from either side of the forward and larger end which is welded shut. The manifold has the appearance of a double T.

Five hoses (7) join the five open terminals of the manifold. One hose connects the open end to the supply line (9) and four hoses connect the four side manifold lines to the four distributor lines. Each distributor line penetrates a brass nipple screwed into a brass flange (4) which is riveted to the carburetor adapter (3). The nipple incorporates a fine hole or nozzle through which the fluid sprays into the adapter. There are four such nozzles and flanges; one on each side of the adapter, and two on the rear. Sprayed into the adapter, the fluid enters the air stream to the carburetor.

2. REMOVAL.

a. Remove attaching clamp.

b. Remove wires and hoses connecting manifold lines to distributor lines.

c. Remove manifold and disconnect distributor line from nipple.

d. Unscrew nipple and flange.

(d) CONTROL VALVE.

1. DESCRIPTION.—The carburetor alcohol anti-icer control valve is located in the pilots' compartment, to the right and above the copilot's panel. It is a shut-off valve which controls the supply of alcohol from the main tank to the carburetor.

2. REMOVAL.

a. Be sure the carburetor anti-icer electric pump is turned off.

b. Disconnect and cap fluid flow lines.

c. Remove handle and four screws on the face of the valve.

3. MAINTENANCE REPAIR OR REPLACEMENT.—A damaged or defective valve shall be replaced.

4. ASSEMBLY AND INSTALLATION.

a. Attach valve to bracket with four face screws and replace handle.

b. Uncap and connect fluid flow lines.

20. OXYGEN SYSTEM

a. GENERAL.—Since air decreases in density at high altitudes, a region is reached where the amount of oxygen normally present in the atmosphere is not sufficient to sustain proper functioning of the human body. In order to maintain the efficiency required to operate a modern airplane, the oxygen present in the atmosphere must be supplemented by oxygen from another source.

To supply this additional oxygen, two types of systems have been used: high pressure and low pressure. The high pressure system operates at a working pressure of 1800 p.s i. The low pressure system operates at a working pressure of 400 p.s.i. The installation in all C-47 and some C-47A airplanes is a high pressure constant flow system which provides oxygen for the crew; the installation in most C-47A and a few hundred C-47B airplanes is a low pressure demand system, supplied by ten F-2 oxygen cylinders, which provides oxygen for the crew; the installation in most C-47B airplanes consists of two low pressure systems, a low pressure demand system supplied by five G-1 cylinders, which provides oxygen for the crew and a low pressure constant flow system supplied by two J-1 cylinders, which provides oxygen for the troop personnel in the main cargo compartment.

WARNING

Remember, that oxygen is to the crew members what fuel is to the airplane. It is compulsory that all equipment be kept in perfect operating condition at all times. A mission may fail through lack of oxygen just as surely as through lack of fuel or oil. Constant vigilance is imperative. Only trained personnel should be allowed to handle oxygen equipment because of the dangers involved. See system precautions in this section.

b. HIGH PRESSURE OXYGEN SYSTEM. — *(See figure 582.)*

(1) DESCRIPTION.—The high pressure oxygen system furnishes a constant flow of oxygen to the user. When the regulator is adjusted corresponding to the altitude, a flow of oxygen is provided which is sufficient to the user while he is at rest. When the user is active, the flow may be increased. The system consists of a Type B-1 oxygen cylinder, a regulating valve, a manifold pressure gage, bayonet-type plug-in socket valves with metering openings, and the necessary lines and connections. The oxygen cylinder is mounted, in a reinforced bracket and held securely by a retaining strap, aft of the rear bulkhead of the pilots' compartment directly behind the co-pilot's seat. An access hole is provided in the bulkhead to make the shut-off and distributor valves readily accessible to the co-pilot. The oxygen regulator is mounted directly on the oxygen cylinder and incorporates a gage which indicates the oxygen pressure remaining in the cylinder. The manifold pressure gage, mounted on the main instrument panel in the oxygen distribution line, indicates the manifold pressure of the oxygen system and is calibrated in feet, representing altitude. The plug-in valves at each crew station incorporate a metering opening in the valve assembly which provides correct oxygen flow at each valve.

(2) OXYGEN CYLINDER ASSEMBLY.—*(See A, figure 582.)*

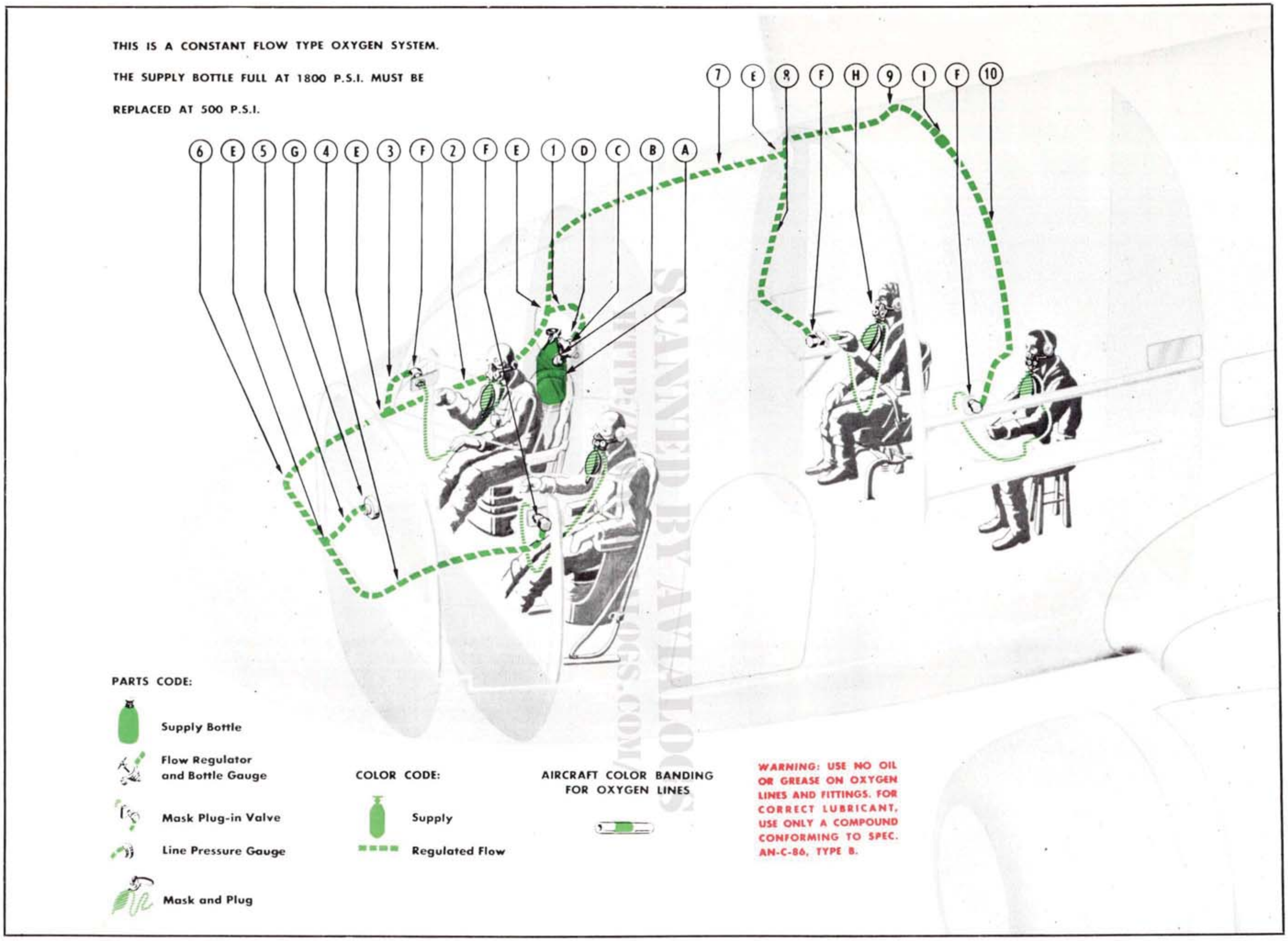
(a) CYLINDER.—The seamless steel oxygen cylinder, Type B-1 (2, figure 583), has a rated capacity of 19.6 cubic feet (1800 p.s.i.).

(b) SHUT-OFF VALVE.—The shut-off valve (2, figure 583) is opened or closed by means of a small wheel which is on the oxygen cylinder. Oxygen is released when the wheel is turned counterclockwise and checked when the wheel is turned clockwise. Be certain, when opening or closing this valve, to turn the wheel to the fullest possible arc.

(c) REGULATOR ASSEMBLY.—The oxygen regulator assembly, located on top of the cylinder (figure 582), includes a flow regulator and a cylinder pressure gage. The oxygen pressure is adjusted by turning the regulator handle clockwise to increase pressure and counterclockwise to decrease pressure.

(3) OXYGEN MANIFOLD PRESSURE GAGE.—The oxygen manifold pressure gage (G, figure 582) is located in the instrument panel. It is of the bourdon type and is calibrated in feet-altitude in order that the correct pressure for any altitude may be obtained by adjusting the manifold pressure gage so that the reading corresponds with the altimeter.

(4) OXYGEN OUTLET VALVE.—The outlets (F, figure 582) for the pilot and co-pilot are located outboard of their respective seats. The outlet for the



THIS IS A CONSTANT FLOW TYPE OXYGEN SYSTEM.

THE SUPPLY BOTTLE FULL AT 1800 P.S.I. MUST BE REPLACED AT 500 P.S.I.

PARTS CODE:

- Supply Bottle
- Flow Regulator and Bottle Gauge
- Mask Plug-in Valve
- Line Pressure Gauge
- Mask and Plug

COLOR CODE:

- Supply
- Regulated Flow

AIRCRAFT COLOR BANDING FOR OXYGEN LINES

WARNING: USE NO OIL OR GREASE ON OXYGEN LINES AND FITTINGS. FOR CORRECT LUBRICANT, USE ONLY A COMPOUND CONFORMING TO SPEC. AN-C-86, TYPE B.

Figure 582—High-Pressure Oxygen System (Also See Figure 649)

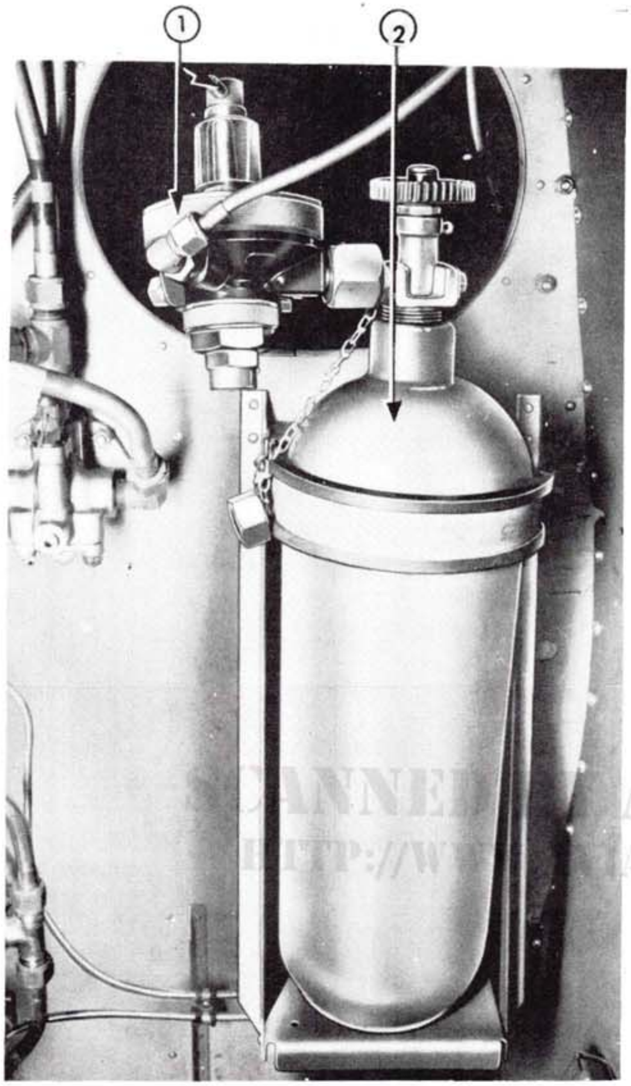


Figure 583—Oxygen Cylinder Installed (High Pressure System)

1. Regulator	2. Cylinder

radio operator protrudes from the underside of the forward radio shelf. The outlet for the navigator is located on the outboard side of the navigator's compartment. An additional outlet, in some models, for the flight mechanic is located aft of the bulkhead in the baggage compartment. These outlet valves are of the plug-in type to fit bayonet type mask plugs.

Note

> All of the above are delicate precision instruments and should be handled with utmost care. No repairs should be attempted. Defective or damaged oxygen equipment, except lines and fittings, should be returned to depot and replaced with new or reconditioned equipment.

(5) OXYGEN LINES.

(a) DESCRIPTION.—All high pressure oxygen lines, designated by green bands, are constructed of aluminum alloy tubing with an outside diameter of ¼ inch.

(b) INSTALLATION.—Refer to figure 582 for guidance in installation of lines.

(c) MAINTENANCE.

1. Remove minor scratches or abrasions with a fine grade emery cloth.

2. Polish with crocus cloth. Do not use oil on the crocus cloth.

3. Replace any lines which are corroded or damaged.

(6) RECHARGING HIGH PRESSURE CYLINDERS.—Recharging of high pressure oxygen cylinders requires the removal of the cylinders from the airplane and the use of special high pressure charging equipment.

(a) REMOVAL OF OXYGEN CYLINDER ASSEMBLY.

1. Disconnect the oxygen distribution line from the regulator.

2. Unfasten the retaining strap and lift the cylinder from the bracket.

(b) INSTALLATION OF OXYGEN CYLINDER ASSEMBLY.

1. Set the cylinder in the airplane on the bracket and fasten the retaining strap.

2. Connect the oxygen distribution line at the regulator.

WARNING

> Handle oxygen cylinders gently at all times during removal and installation. The cylinders must not be dropped or dented, because of the obvious danger of an explosion. Hands and clothing must be dry and free of grease.

(7) TESTS OF HIGH PRESSURE OXYGEN SYSTEM.

(a) LEAK TEST.

1. Make certain the oxygen regulator control handle is in the full OFF position.

2. Open the oxygen cylinder shut-off valve fully.

3. Open the oxygen pressure regulator by turning the handle control clockwise slowly but completely.

4. Note the reading of the oxygen cylinder pressure gage, which should be approximately 1800 psi at 21°C (70°F).

5. Note the reading of the oxygen manifold pressure gage on the instrument panel, which should be approximately 25,000 feet.

6. Apply a solution of an approved bubble fluid or of toilet soap to all fittings and determine if any leakage exists as evidenced by bubbles. The part tested shall be carefully wiped clean and dry immediately after test.

WARNING

> Never use a mixture containing oil or grease on any connection, packing, valves, gages, or other oxygen equipment. Failure to observe these precautions may result in an explosion.

(b) OPERATION TEST.

1. Turn the regulator handle control counterclockwise to the full OFF position.

2. Remove all mask plugs from the oxygen outlet valves.

3. Open the oxygen cylinder shut-off valve.

4. Turn the oxygen pressure regulator handle control clockwise until the reading of the manifold pressure gage on the instrument panel is between 24,000 and 25,000 feet.

5. Close both the oxygen pressure regulator and the oxygen shut-off valve.

6. Tap both the cylinder pressure gage and the oxygen manifold pressure gage with knuckle and note the readings.

7. After 10 minutes, again tap the two gages and take readings. There shall be no drop allowable for the ten minute period. If leaks are indicated by above procedure, system must be reworked until satisfactory.

WARNING

> Keep all materials, tools, and equipment which may come in contact with oxygen under pressure, absolutely clean.

(8) EFFECT OF TEMPERATURE CHANGES ON OXYGEN SYSTEM. – Refer to paragraph 20.*e.* following.

(9) DURATION OF OXYGEN SUPPLY.—To compute duration of supply see paragraph 20.*f.*(2).

c. LOW PRESSURE DEMAND SYSTEMS.

(1) GENERAL DESCRIPTION.—The low pressure demand systems provide crew members with the proper amount of oxygen at various altitudes and under other conditions that call for supplementary oxygen. As the name implies, the systems furnish oxygen only on demand; that is, each time the user inhales, oxygen properly diluted with air is delivered to the mask. In most C-47A and a few hundred C-47B airplanes the system is supplied by ten Type F-2 oxygen cylinders. In most C-47B airplanes the system is supplied by five Type G-1 oxygen cylinders. These cylinders, located under the floor at the rear of the main cargo compartment, are fitted with check valves which prevent loss of the entire supply in event any of the cylinders are punctured by gun fire. A demand regulator, and a panel mounting containing a flow indicator, pressure signal warning lamp, and pressure gage, are located at each crew station. When oxygen is needed, the tube on the regulator is connected to the hose on the user's mask. Inhaling opens the valve in the regulator, which permits a mixture of air and oxygen to be released to mask. The flow indicator on the panel mounting "blinks" each time a flow of oxygen passes through to the mask. The pressure gage, mounted on the panel, indicates the oxygen supply available in cylinders. The pressure signal lights the warning signal lamp when supply becomes dangerously low. (This pressure signal and warning lamp are on only early C-47B airplanes.) Portable apparatus is installed at pilot's, co-pilot's, and navigator's stations. The low pressure demand systems are fully automatic and no adjustment of instruments is required by user, once he dons his mask.

Note

> Oxygen instruments are precision mechanisms and should be handled with care. No repairs should be attempted. Defective or damaged equipment, except lines and fittings, should be returned to depot and replaced with new or reconditioned equipment.

(2) CYLINDERS.

(a) DESCRIPTION OF 10 CYLINDER SYSTEM. *(See figure 584 and diagram in airplane mounted on door at forward end of main cargo compartment.)*—Ten shatterproof Type F-2 oxygen cylinders, with a pressure of 425 ± 25 psi and a capacity of 13.8 cubic feet, are strapped in wooden cradles below the main cargo compartment floor. (See figure 586.) On some airplanes the whole amount of oxygen is at the disposal of all five crew members, whereas, on later airplanes the pilot is supplied by two cylinders isolated from the rest of the system, and the other four crew members are supplied by the remaining eight cylinders.

(b) DESCRIPTION OF 5 CYLINDER SYSTEM. *(See figure 588A and the diagram mounted on door at forward end of main cargo compartment.)*—Five yellow-lacquered cylinders, Type G-1, are installed under the floor opposite the main cargo door by means of Alclad straps, and tightened with turnbuckles. These cylinders, of light-weight high-grade nonshatterable steel, have a working pressure of approximately 400 psi, show no tendency to shatter, seldom rocket, and never burn when hit. The cylinder nearest the filler valve is for the pilot; the other four are for the rest of the crew. The five cylinders are manifolded together so that the pilot's supply is separated by a check valve from the remainder of the crew system to prevent the entire supply from being lost in event any cylinder is hit by gun fire. The supply of oxygen from these five cylinders of the "crew system" may be supplemented by the contents of the two large J-1 cylinders, from the constant flow "troop system," which are located on the floor at the rear of main cargo compartment, by opening the line valve which on C-47A and early C-47B airplanes is located at the filler box next to the main cargo door, and on later C-47B airplanes is located at floor level on right side at station 476. It is, however, impossible to dispense oxygen from the demand system to the constant flow system.

(c) FILLING THE CYLINDERS.

1. GENERAL INSTRUCTIONS.—Be certain that hands, tools, and clothing are dry and free of oil and grease, because there is great danger of fire and explosion if oil or grease comes in contact with oxygen under pressure. Be careful that dust, dirt, or other foreign matter does not contaminate any oxygen equipment as the clogging of lines and instruments may result. Be certain that no moisture enters the system. Moisture freezes at high altitudes with resultant clogging of equipment.

2. GRADE OF OXYGEN.—Only oxygen, specification AN-O-1a, may be used. This grade of oxygen has a minimum moisture content of .035 milligrams per liter; it is odorless and free of all foreign matter including drying agents. Even though the manufacturer supplies oxygen of this dryness, as an added precaution, it should always be passed through the aridifier which is installed on the recharging cart.

WARNING

Never fill a low pressure oxygen system from a storage cylinder without a pressure reducing regulator to reduce the high pressure to the safe working pressure of the low pressure system.

3. OPERATION OF FILLING SYSTEM.—*(See figure 585.)*

a. Clean the filler valve and filler adapter as noted in TEST OF OXYGEN EQUIPMENT, paragraph 20.*g*.

b. Check position of line valve, which should be closed unless troop system is to be serviced.

c. Check to see that all regulator emergency valves are "OFF."

d. Turn filler valve about ¼ turn to release dust plug.

e. Insert filler adapter of AAF filling equipment into oxygen system filler valve until it clicks.

f. Open the valve on the top of the oxygen filling supply cylinder slowly one full turn, making certain the oxygen pressure regulator is in the "OFF" position.

g. Open the shut-off valve at end of filler hose.

h. Screw down the handle on the ground filling pressure regulator slowly, filling the system at not more than 25 psi per minute, until the pressure gage reaches 425 psi. Do not exceed 450 psi. The pressure may fall to about 400 psi when the cylinders cool.

i. Close filling equipment regulator valve and disconnect adapter from filler valve.

j. Insert dust plug in filler valve.

k. Check each station to see that pressure gage readings are within ±25 psi of charging pressure.

l. If the pressure, as indicated on the airplane gage, fails to rise refer to TROUBLE SHOOTING chart at end of this paragraph (20.*h*.).

m. Fill the portable cylinders to capacity.

(d) MAINTENANCE. — Defective cylinders should be returned to the major overhaul depot and replaced by new ones.

CAUTION

Handle oxygen cylinders carefully at all times during removal and installation. They must not be dropped or dented, because of the obvious danger of explosion. Hands and clothes must be dry and free of dirt or grease.

(e) REMOVAL.

1. Release all oxygen from the system by opening all oxygen regulators, or by inserting British adapter in the portable recharging valves.

2. Remove all line fittings from cylinders.

3. Remove safety wires from turnbuckles and loosen turnbuckles.

4. Lift out cylinders.

5. Cover ends of all open lines with cellulose (scotch) tape. DO NOT USE FRICTION TAPE.

(f) INSTALLATION.

1. Lift cylinders into position on brackets and install the padded straps around them.

2. Tighten the turnbuckles and safety with lockwire.

3. Remove cellulose tape from lines and coat male threads on line fittings sparingly with Rectorseal No. 15.

4. Attach lines to respective cylinder fittings.

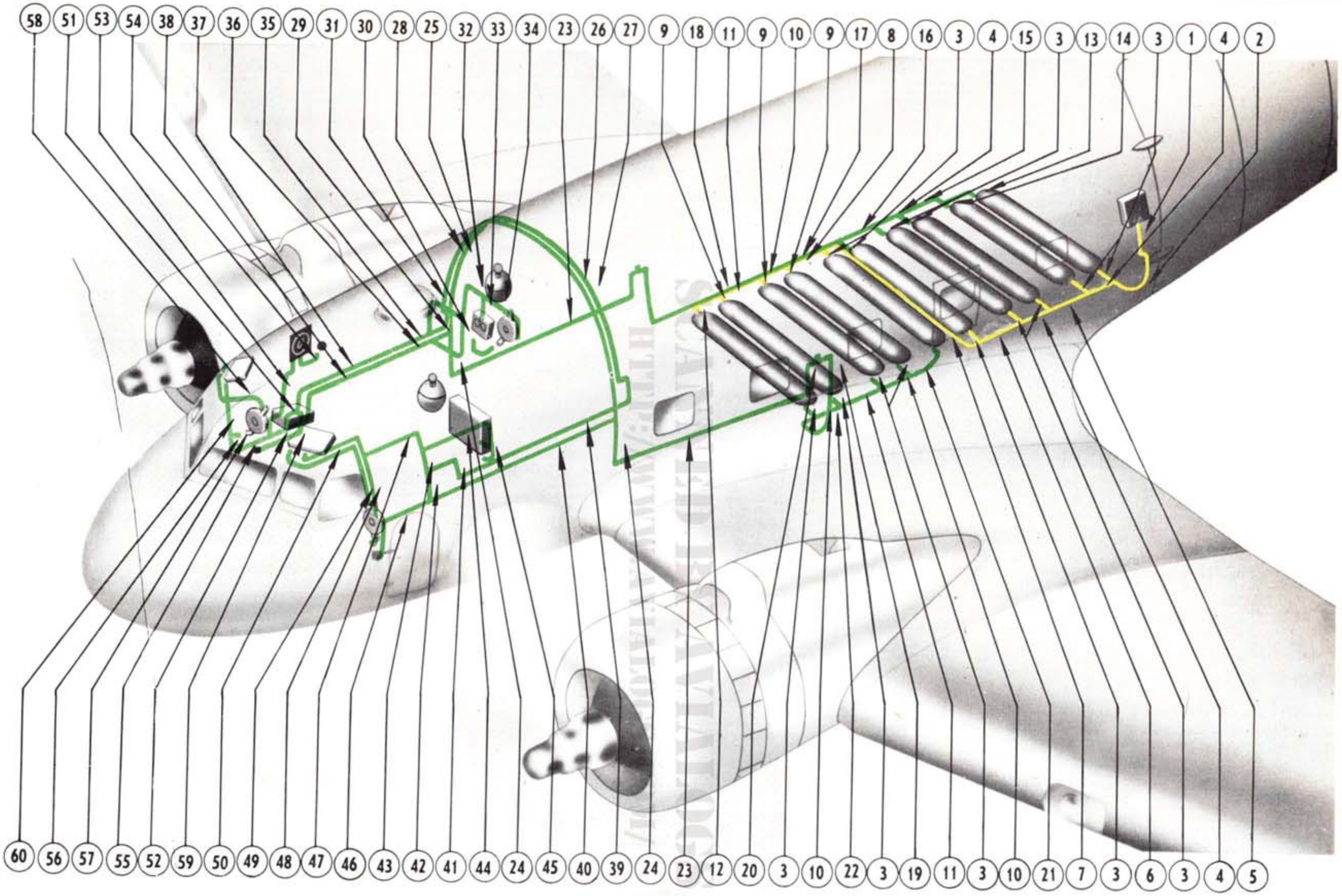
(3) LINES AND CONNECTIONS.

(a) DESCRIPTION.—The lines are of 52SO aluminum alloy tubing, with an outside diameter of 5/16 of an inch and a wall thickness of .035. Elbows, tees, crosses, and unions are of 24ST aluminum alloy. Steel fittings are never used. Lines are mounted by means of clips, to prevent chafing and vibration. At the clips and where the tubing passes through structure, protection is gained by means of grommets. To facilitate the making of connections and to allow for expansion and contraction, perfectly straight runs have been avoided whenever possible. The lines are banded in color for identification, green for supply lines and green, yellow, green for filler lines.

(b) MAINTENANCE AND REPLACEMENT.

1. All tubing to be used in replacement in low pressure systems must be aluminum alloy 5/16 inch x .035 inch wall conforming to Specification WW-T-787. Use copper tubing only when aluminum alloy tubing is not available. All fittings should be of the AN flared tube type conforming to Specification AN-WW-F-366. Type 811 fittings may be used when AN fittings are not available. All tubing on late C-47B airplanes has the double flare ends.

2. Tightening of flared tubing shall be accomplished in accordance with the best commercial practice. The tightening shall not be so excessive as to shear or tend to shear off the flared end of the tube. Torque wrenches may be used but the torques shall not exceed 100 inch-pounds.


58
51
53
54
38
37
36
35
29
31
30
28
25
32
33
34
23
26
27
9
18
11
9
10
9
17
8
16
3
4
15
3
13
14
3
1
4
2
60
56
57
55
52
59
50
49
48
47
46
43
42
41
44
24
45
40
39
24
23
12
20
3
10
22
3
19
11
3
10
21
7
3
6
3
4
5

COLOR CODE:
🟩 Distribution Lines
🟨 Filler Lines

AIRCRAFT COLOR BANDING FOR OXYGEN LINES
Distribution Lines
Filler Lines

THIS IS A DEMAND TYPE OXYGEN SYSTEM. SYSTEM PRESSURE MUST NOT EXCEED 450 P.S.I. WHEN FILLING AND MUST NOT FALL BELOW 50 P.S.I. BEFORE REFILLING.

WARNING: OXYGEN FITTINGS, INSTRUMENTS AND ALL GROUND EQUIPMENT MUST BE KEPT ABSOLUTELY FREE FROM OIL, GREASE AND DIRT.

Figure 584—Low-Pressure Oxygen System (Also See Figures 650 and 651)

3. All aluminum alloy straight threads will be treated with approved AN-C-86 anti-seize compound, only if experience shows that the threads are seizing. All brass pipe threads and aluminum alloy pipe threads must be treated with Type AN-C-86 anti-seize compound. This compound is specifically approved for use in oxygen systems. It shall be used and applied in accordance with the manufacturer's recommendations. Caution must be exercised to insure that the compound is carefully and sparingly put only on the male threads, making sure that none enters the tubing.

a. Deleted.

b. In emergency only, in the field, when the above mentioned compounds are not available, litharge (yellow lead oxide) and glycerine may be used for sealing pipe threads.

c. The above compounds shall never be used on flared tube fittings to prevent oxygen leakage. Proper tube flaring and assembly of flared tube fittings are sufficient to prevent leakage.

4. Because lines subjected to rough flights may vibrate loose, they shall be inspected after every flight; loose connections must be tightened. Do not attempt to repair broken, deformed, cracked, or shattered tubing. Replace with new tubing.

5. LINES IN THE 10 CYLINDER INSTALLATION.—Refer to figures 584 and 650 for guidance in installing the lines of this system.

6. LINES IN THE 5 CYLINDER INSTALLATION.—Refer to figures 588A and 651A for guidance in installing the lines in this system.

7. TESTING LINES.—Refer to TROUBLE SHOOTING CHART and LEAK TESTS in paragraph 20.*g.* and *h.* the end of this section.

CAUTION

Oxygen lines shall never be disconnected when the system is under pressure, because fire or explosion may result if oxygen under pressure is released where it can come in contact with hydraulic fluid or other combustible material.

(4) VALVES.—Three types of valves are used.

(a) CHECK VALVES.—Check valves are installed to prevent excessive loss of oxygen in event cylinders or portion of connecting lines are destroyed by gun fire. The action is automatic.

1. In the ten cylinder system, check valves are installed on both ends of each cylinder (See E and F, figures 651 and 587). A style "D" check valve (See F, figure 651) installed in the distribution line, exerts a dual check, preventing the backflow of oxygen into the cylinder itself or into other cylinders. A style "A" check valve (See E, figure 651) installed in the filler end prevents the backflow of oxygen from the cylinder into the filler line. On later airplanes ten style "B" check valves, installed on the cylinders, perform the dual check on both the distribution and filler lines, and the ten style "A" check valves are eliminated.

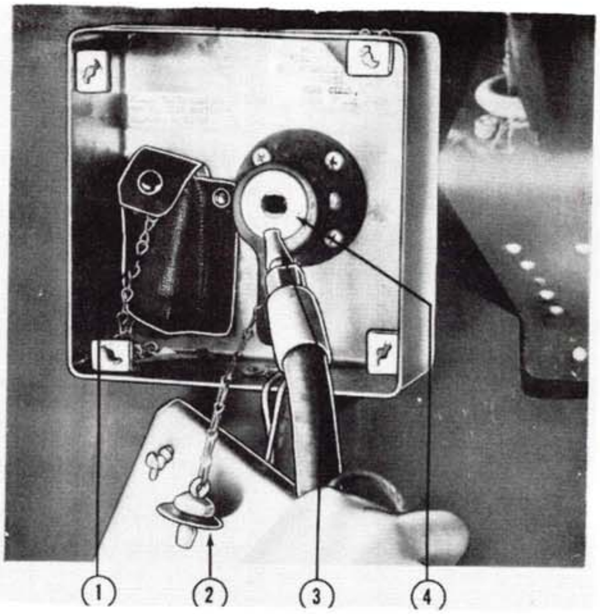


Figure 585—Filling the System

1. British Adapter
2. Chained Dust Plug
3. Filler Adapter (Nozzle)
4. Filler Valve

2. In the five cylinder system a style "B" check valve on each of the two forward cylinders (See 12, figure 588A) performs the check.

(b) SHUT-OFF VALVE.—Two shut-off or line valves, in C-47 and a few C-47A airplanes, are located in the cargo compartment (H, figure 651) and serve as a means of shutting off the cylinders from dispensing stations. They are opened by turning counterclockwise for flight, and closed by turning clockwise for instrument change, testing, or to prevent loss of oxygen if damage has occurred forward of the valve.

(c) FILLER VALVE.—A filler valve in a metal box is located just forward of the main cargo door. (On C-47A and early C-47B airplanes, see A, figure 651 and 4, figure 585 for the ten cylinder system; or 15, figure 588A for the five cylinder system; for late C-47B airplanes see figures 651B, 585, and 588B.) The adapter of the ground filling equipment hose is fitted into this filler valve when the system is recharged. When filler valve is not in use, a plug excludes dust and other contamination from the valve. A British adapter, used to accommodate the nozzle on the British ground filling equipment, is stowed alongside the filler valve. Late C-47B airplanes are not equipped with the adapter. On late C-47B airplanes the filler valve is accessible from the outside by means of an access door just to the left and down from the lower edge of the main cargo door.

(d) INSTALLATION.—Refer to figure 651 when installing valves on the ten cylinder system and to figure 588A when installing valves on the five cylinder system. Be sure that the check valves are installed in the proper direction; the check valve arrows shall point in the direction of the flow.

(e) TESTING VALVES.—Refer to TROUBLE SHOOTING CHART and LEAK TESTS in paragraph 20.*g.* and *h.* the end of this section.

(5) DEMAND REGULATOR.

(a) DESCRIPTION.—This regulator, either Army Type A-12 (figure 588) or AN6004-1, which is similar, is connected to the hose of the demand type mask by means of a demand-mask-to-regulator tube. The regulator is installed as a permanent fixture of the airplane, one at each crew station: pilot, co-pilot, navigator, radio operator, and flight mechanic. It has an "auto mix" lever which when "ON" furnishes a proper mixture of air and oxygen and when "OFF" furnishes only pure oxygen on demand. For most of the conditions in which oxygen is needed, the regulator should be used in the "ON" position and the emergency valve closed. This permits the automatic mixing of air and oxygen and increases the percent of oxygen content with the increase in altitude until approximately 100% pure oxygen is dispensed at an altitude of about 30,000 feet with the A-12 regulator and at an altitude of about 35,000 feet with the AN6004-1 regulator. Conditions calling for the use of the regulator in the "OFF" position are infrequent. Usually this position is used only on the order of the flight surgeon. Notice that the "OFF" designation means that the auto-mixing function, *not the oxygen flow*, has been shut off. When demand mechanism fails, or when a crew member is unconscious, use the emergency valve which by-passes the demand mechanism of the regulator and supplies a continuous flow of oxygen into the mask. This is an emergency device and should be used strictly as such.

Note

To reduce oxygen loss, the emergency valve must be safetied in the "CLOSED" position after use.

(b) INSTALLATION.

1. Check to see that there is no pressure in the line, or close the line shut-off valve, if there is one.

2. Apply a small amount of approved thread compound, Specification No. AN-C-86, to the male pipe threads.

3. Screw the fitting into the boss directly under the emergency valve knob.

4. Attach the supply line and tighten nut.

5. Screw the elbow into the outlet boss opposite the auto-mix lever.

6. Fasten the mounting plate of the regulator to the panel with bolts.

7. Connect the outlet elbow of the regulator to the flexible mask-to-regulator tube.

8. Check connections for leaks as specified in leak test following.

9. With emergency valve knob in "CLOSED" position, safety the valve with annealed copper wire no larger than .0179 inch in diameter.

(c) REMOVAL.—Reverse the installation procedure above.

(d) TESTING REGULATOR.—Refer to TROUBLE SHOOTING CHART and LEAK TESTS in paragraph 20.*g.* and *h.* the end of this section.

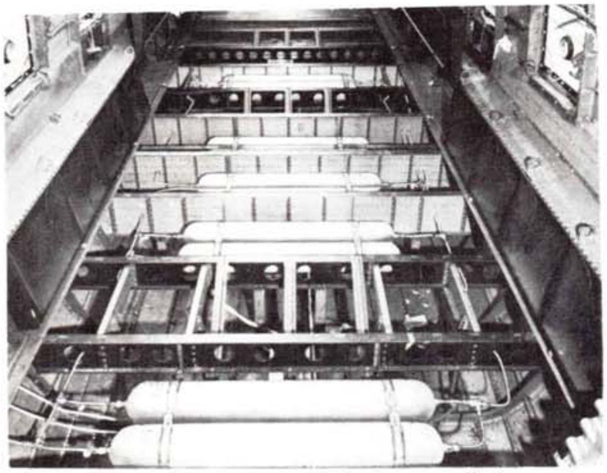


Figure 586—Oxygen Cylinders Installed (Low-Pressure System)

(6) PRESSURE GAGE.

(a) DESCRIPTION.—This Bourdon-tube type gage, Army Type K-1, is used to indicate the pressure of the oxygen in the supply cylinders in pounds per square inch. It is mounted on a panel with an Army Type A-3 oxygen flow indicator and a warning signal lamp assembly. (See figure 651 for ten cylinder system and 21, figure 588A for five cylinder system.)

(b) INSTALLATION.

1. Screw the fitting into the back of the gage.

2. Attach the mounting plate of the gage to the panel.

3. Connect the supply line to the back of the gage fitting.

(c) REMOVAL.—Reverse the installation procedure as given above.

(d) TESTING PRESSURE GAGE.—Refer to TROUBLE SHOOTING CHART and LEAK TESTS in paragraph 20.*g.* and *h.* the end of this section.

(7) FLOW INDICATOR.

(a) DESCRIPTION.—This "blinker" indicator, Army Type A-3 (AN6029-1) (See figures 651 and 588 for ten cylinder system and 2, 5, 6, 11, figure 588A for five cylinder system), contains a bellows which blinks the shutter only when oxygen passes through the regulator. For this reason at ground level the shutters do not operate with Auto-Mix "ON" or if emergency is on at any altitude. Failure of shutters to operate at altitude is an indication that oxygen has ceased to flow through regulators; in which event the user should immediately switch to pure oxygen.

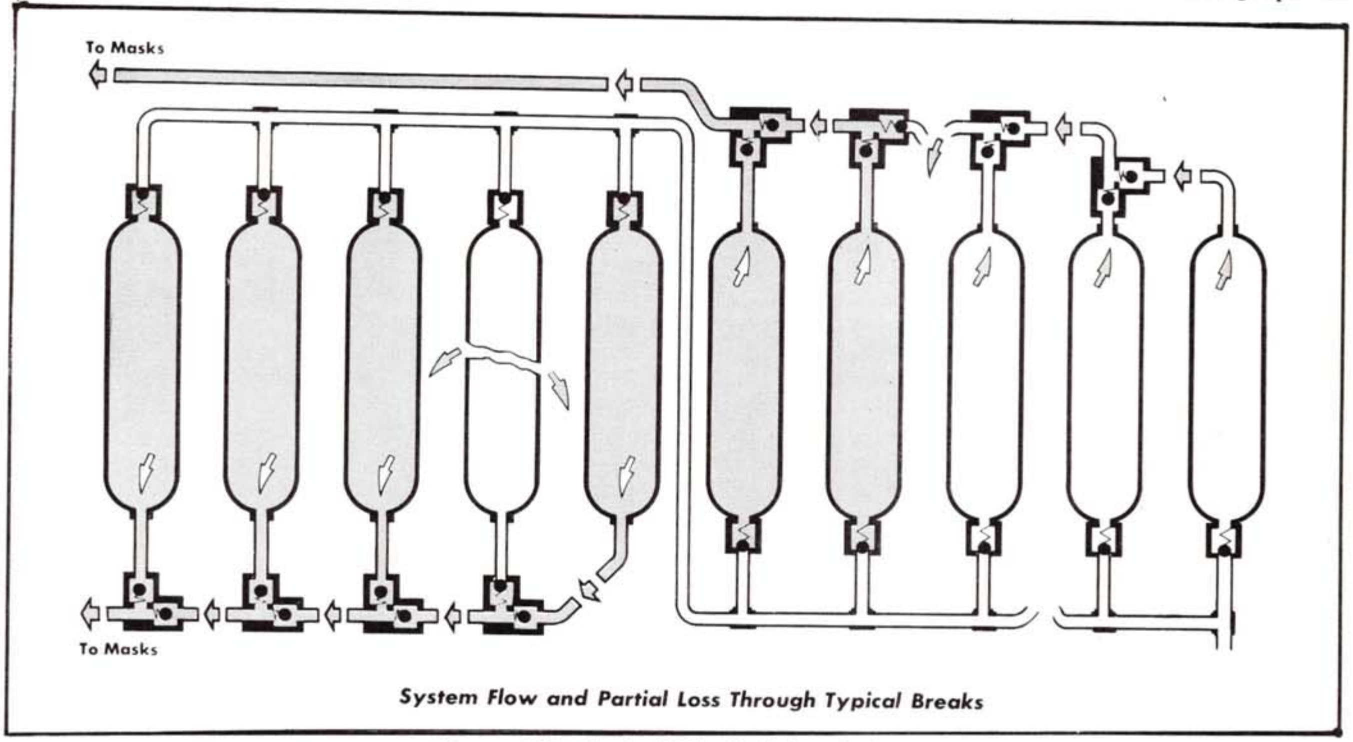
(b) INSTALLATION.

1. Attach the flow indicator to the panel with bolts.

2. Connect the flow indicator line, opposite the Auto-Mix lever, to the regulator outlet.

3. Connect the other end of the line to the fitting at the back of the flow indicator.

(c) REMOVAL.—Reverse the installation procedure as given above.



System Flow and Partial Loss Through Typical Breaks

Figure 587—Typical Check Valve Action

(*d*) TESTING FLOW INDICATOR.—Refer to TROUBLE SHOOTING CHART and LEAK TESTS in paragraph 20.*g*. and *h*. the end of this section.

(8) WARNING SIGNAL LAMP.—This amber lamp (late C-47A and early C-47B airplanes only) lights when the pressure in the system falls below 100 psi. It is actuated by a pressure signal in supply lines.

(9) PRESSURE SIGNAL. — This signal, Army Type G-1, (late C-47A and early C-47B airplanes only) is a pressure switch which indicates when supply falls below 100 ± 10 psi by an electrical contact on the Bourdon tube. This contact lights the amber warning lamp on the panel with gage and flow indicator.

(10) PORTABLE APPARATUS.

(*a*) DESCRIPTION.—Three walk-around assemblies (See figures 651 and 588 for the ten cylinder system and 8, figure 588A for the five cylinder system) are available for use by crew members who must move about in the airplane and also for use in case of emergency. They are located at the stations of the pilot, copilot, and navigator. On C-47A and early C-47B airplanes each unit consists of any Army Type A-4 low pressure walk-around cylinder, lacquered green instead of the usual yellow, and an Army Type A-13 low pressure demand regulator. On some C-47B airplanes (see figure 588B) there is an additional unit added on the right forward side of the bulkhead at station 538. Each of the four units consists of a large capacity type A-6 low pressure walk-around cylinder with an Army Type A-15 low pressure regulator. Before moving about, the user disconnects the hose of his demand mask from the regulator tube at his station and inserts the male end of it into the mask outlet provided under the dust cap on the portable regulator. The cylinder may be recharged by inserting the adaptor on the regulator into the filler valve of the walk-around unit recharger assembly. The supply is approximately thirty minutes. ALWAYS refill before returning it to its place. On late C-47B airplanes there are four additional recharger assemblies, one located on each side of the airplane on station 177½; and one located on the forward and one on the aft side of station 538.

(*b*) TESTING PORTABLE APPARATUS. — Refer to TROUBLE SHOOTING CHART and LEAK TESTS in paragraph 20.*g*. and *h*. the end of this section.

(11) EFFECT OF TEMPERATURE CHANGES ON OXYGEN SUPPLY.—Refer to paragraph 20.*e*.

(12) DURATION OF OXYGEN SUPPLY.—For this calculation refer to paragraph 20.*f*.(3) following.

d. LOW PRESSURE CONSTANT FLOW SYSTEM. —(*Figure 588A and diagram on forward cargo door.*)

(1) DESCRIPTION.—This system, as the name implies, furnishes a constant flow of oxygen to the user. Two Type J-1 low pressure oxygen cylinders are located on the floor at the rear of the main cargo compartment, and are recharged through the filler valve which is above the floor forward of the main cargo door. A panel, containing three A-11 regulators, a pressure gage, a warning signal, and a warning light, is at the rear of the main cargo compartment. A supply line, running along each side of fuselage above the windows, contains 28 couplings. The fitting on the hose end of a constant flow oxygen mask, Type A8-B, is inserted into the nipple end of a coupling. The coupling automatically shuts off when the mask is disconnected.

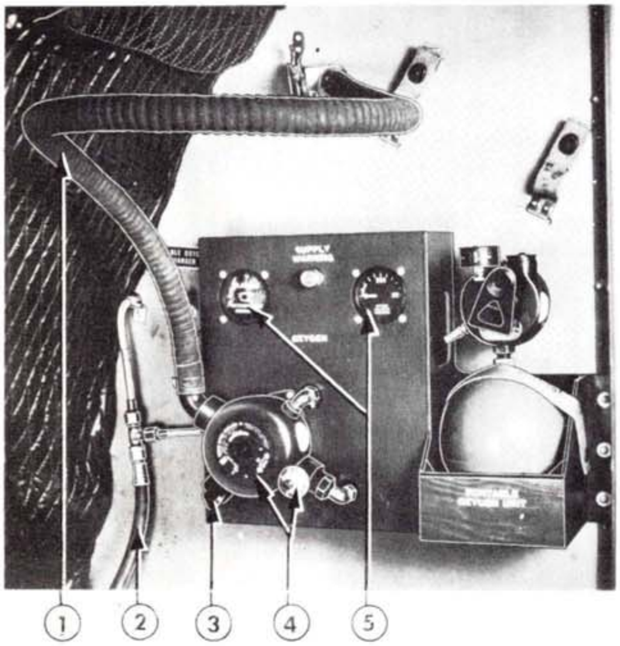


Figure 588—Navigator's Oxygen Equipment

1. Corrugated Mask Tubing (Open Dust Cap When Emergency Is "ON")
2. Recharger Hose (Used to Recharge Portable Units)
3. Auto-Mix Control Lever (Should Be "ON" for Flight, "OFF" for Instrument Tests)
4. Emergency Valve Knob. (Should Be Turned "ON" Only to Reduce Pressure in System or During Flight Emergencies)
5. Pressure Gage (Should Register 425 ± 25 psi.)

Note

> All oxygen instruments are delicate precision mechanisms and should be handled with utmost care. No repairs should be attempted. Defective or damaged oxygen equipment, except lines and fittings, should be returned to depot and replaced with new or reconditioned equipment.

(2) CYLINDERS.—Two yellow-lacquered cylinders, Army Type J-1, are placed on the floor opposite the main cargo door (16, figure 588A) and are held in position by temporary straps. They are connected to the oxygen line by flex hose, are Government equipment, Government installed, and are furnished only when the cargo compartment is used for troop personnel or when a long range flight is anticipated.

(3) OXYGEN INSTRUMENT PANEL.

(a) REGULATORS.

1. DESCRIPTION.—Three Army Type A-11 regulators (7, figure 588A) are connected in parallel on an oxygen instrument panel, which is installed at the rear of the main cargo compartment, opposite the cargo door. Each regulator is capable of supplying oxygen to as many as 15 men. The flow of oxygen for various altitudes is automatically regulated by an aneroid barometer in the regulator. No manual control required.

2. TESTING.—See paragraph 20.*g*.(4), at end of this section on TESTING CONSTANT FLOW OXYGEN SYSTEM.

(b) PRESSURE GAGE.

1. DESCRIPTION.—This Bourdon-tube type gage, Army Type K-1 (AN6021-1), is located on the instrument panel (31, figure 588A) with the three A-11 regulators. It is used to indicate the pressure of the oxygen in pounds per square inch.

2. TESTING.—See paragraph 20.*g*.(4), at end of this section on TESTING CONSTANT FLOW OXYGEN SYSTEM.

(c) WARNING SIGNAL ASSEMBLY.
(See figure 588A.)

1. DESCRIPTION.—This warning signal, Army Type G-1, is a pressure switch which indicates when the supply of oxygen falls below 100 psi, by an electrical contact on the Bourdon tube. The contact lights the amber lamp on the oxygen instrument panel at 100 ± 10 psi. This warning signal and warning lamp are on late C-47A and early C-47B airplanes only.

2. MAINTENANCE AND REPLACEMENT.—No maintenance, other than the replacement of burned out electric bulbs, is necessary. No repairs should be made; return a damaged signal to depot and replace with a new one.

3. TESTING.—See paragraph 20.*g*.(4) at end of this section on TESTING CONSTANT FLOW OXYGEN SYSTEM.

KEY TO FIGURE 588A

Item	*Name*
1.	Oxygen System Diagram Assem.
2.	Flow Indicator
3.	Duration Chart
4.	Regulator (Radio Operator's) Tube Assem.
5.	Panel (Flight Mechanic's) Flow Indicator Regulator Tube Assem.
6.	Bracket Flow Indicator Pressure Gage Lamp Assem. (Late C-47A & Early C-47B Airplanes Only)
7.	Regulator Tube Assem. (Pilot & Co-pilot) Tube Assem. (Navigator) Recharger Assem.
8.	Portable Cylinder
9.	Type G-1 Pressure Signal (Late C-47A & Early C-47B Airplanes Only)
10.	Chart Assem.
11.	Panel (Navigator) Flow Indicator Pressure Gage Lamp Assem. (Late C-47A & Early C-47B Airplanes Only)
12.	Check Valve—Style "B"
13.	Low Pressure Type G-1 Oxygen Cylinder
14.	Line Valve
15.	Box Bag Assem. Chain Assem. Type 1 Filler Valve Adaptor—Army to British
16.	Type J-1 Cylinder Hose Assem. Bag Assem. Cap Plug
17.	Instrument Panel
18.	Regulator
19.	Type G-1 Pressure Signal (Late C-47A & Early C-47B Airplanes Only)
20.	Lamp Assem. (Late C-47A & Early C-47B Airplanes Only)
21.	Type K-1 Pressure Gage
22.	Manifold

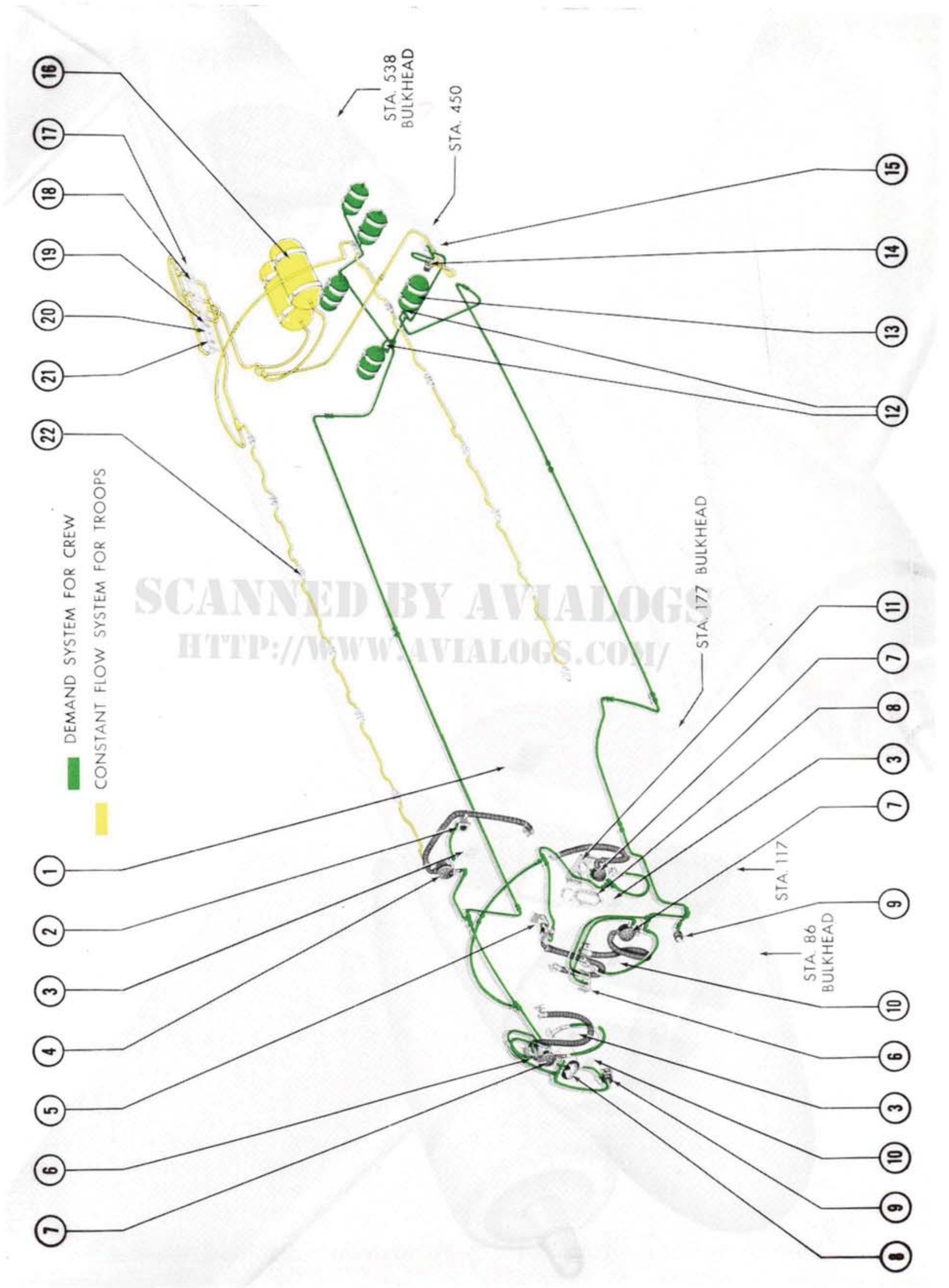

🟩 DEMAND SYSTEM FOR CREW
🟨 CONSTANT FLOW SYSTEM FOR TROOPS
STA. 538 BULKHEAD
STA. 450
STA. 177 BULKHEAD
STA. 117
STA. 86 BULKHEAD
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

Figure 588A—Low Pressure Demand and Constant Flow Oxygen Systems

(4) LINES.—The tubing used in the constant flow system is identical with the tubing used in the demand system. Use figure 651A as a guide for proper installation.

(5) MANIFOLD ASSEMBLY.
(See 22, figure 588A.)

(a) DESCRIPTION. — Twenty-eight automatic couplings are provided for the Type A8-B oxygen masks. These couplings are mounted in pairs, in dural manifolds located in the supply lines which run above the windows in the main cargo compartment.

(b) MANIFOLDS.—These manifolds, connected into the lines by nipples and fixed onto a longeron by metal clamps, need no maintenance. Replace a damaged manifold with a new one.

(c) COUPLINGS.—Two couplings are installed in each manifold. When oxygen is needed, the bayonet fitting on the hose end of the constant flow oxygen mask is inserted into the end of the coupling. When the mask is disconnected the coupling automatically shuts off. No maintenance is necessary. Replace a damaged coupling with a new one.

(d) TESTING.—See paragraph 20.*g*.(4) at end of this section on TESTING CONSTANT FLOW OXYGEN SYSTEM.

(6) EFFECT OF TEMPERATURE CHANGES ON OXYGEN SYSTEM.—Refer to paragraph 20.*e*. following.

(7) DURATION OF OXYGEN SUPPLY.—For computing the duration of supply refer to paragraph 20.*f*.(4) following.

e. EFFECT OF TEMPERATURE CHANGES ON OXYGEN PRESSURE.—When the airplane ascends from ground level, where the temperature may be quite high, to considerable altitude where the temperature is comparatively low, there will be pressure drop in the oxygen system due to the temperature change of the cylinders. The pressure may drop as much as 100 pounds. This drop does not mean that any of the oxygen is lost. The same quantity of oxygen is still there, but the drop in temperature has caused a drop in pressure.

TEMPERATURE CORRECTION CHART

If the temperature rises the number of degrees shown in the outside columns, pressure rises should not exceed the corresponding number of pounds shown in the middle column. If temperature drops the number of degrees shown in outside columns, the number of pounds pressure drop should not exceed that shown in the middle column.

Temperature Change in degrees Fahrenheit	*Pressure Change in Pounds per Square Inch*	*Temperature Change in degrees Centigrade*
	3	2
5	4	
	6	4
10	8	
	10	7
15	12	
	14	10
20	16	
	18	13
25	20	
	21.5	15
30	24	
	26	18
35	28	
	30	21
40	32	
	34	24
45	36	
	37	26
50	39	28

This chart is designed for average starting condition of 70°F. (21°C.) and 29.92" barometric pressure, but should be reasonably applicable to general conditions experienced at ground level.

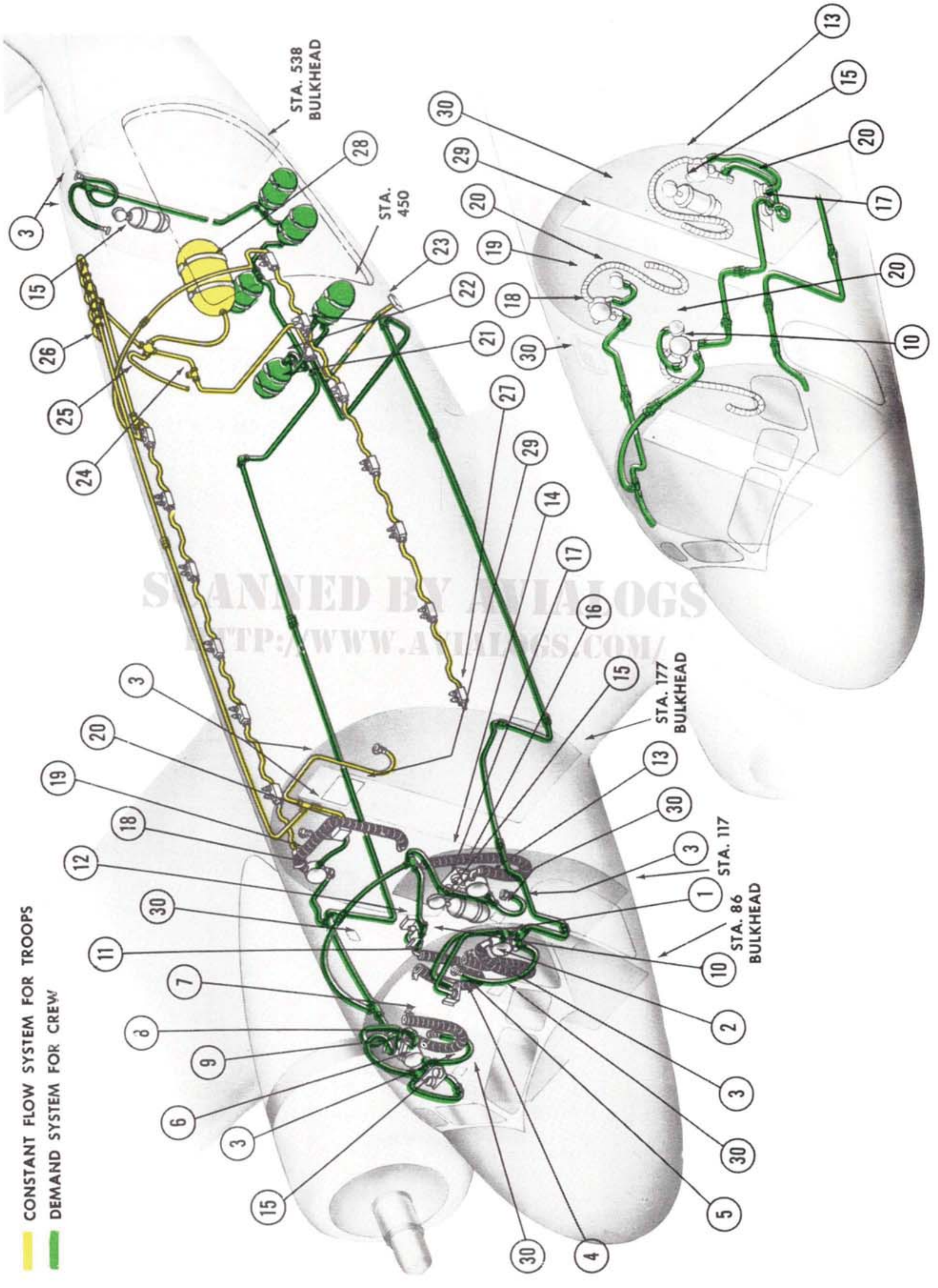

🟨 CONSTANT FLOW SYSTEM FOR TROOPS
🟩 DEMAND SYSTEM FOR CREW
STA. 538 BULKHEAD
STA. 450
STA. 177 BULKHEAD
STA. 117
STA. 86 BULKHEAD
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30

Figure 588B—Low Pressure Demand and Constant Flow Oxygen System (Late C-47B Airplanes)

KEY TO FIGURE 588B

1. Regulator (Pilot)
2. Tube Assembly
3. Recharger Assembly
4. Flow Indicator (Pilot)
5. Pressure gage
6. Regulator (Copilot)
7. Tube Assembly
8. Flow Indicator (Copilot)
9. Pressure Gage
10. Regulator (Crew Chief)
11. Tube Assembly
12. Flow Indicator
13. Regulator
14. Tube Assembly
15. Portable Oxygen Cylinder and Regulator
16. Flow Indicator
17. Pressure Gage
18. Regulator (Radio)
19. Tube Assembly
20. Indicator Assembly
21. Low Pressure Oxygen Cylinder-Type G-1
22. Check Valve—Style "B"
23. Filler Valve Adaptor—Army to British
24. Line Valve
25. Hose Assembly
26. Instrument Panel
27. Manifold
28. Low Pressure Oxygen Cylinder—Type J-1
29. Oxygen System Diagram Assembly
30. Duration Chart Assembly

f. DURATION OF OXYGEN SUPPLY.

(1) GENERAL.—The amount of oxygen contained in a cylinder is directly proportional to the pressure. All duration values are expressed in man-hours (the number of hours the supply will last for one man). These estimates are based on NORMAL USE of oxygen at a specified altitude. If emergencies arise calling for use of the emergency valve (in the low pressure demand system) or exceptionally high flow rates (in the high pressure continuous flow system), or if cylinders are punctured by gun fire, the duration obviously will be reduced.

(2) HIGH PRESSURE CONSTANT FLOW OXYGEN DURATION COMPUTATION.—Table 1 gives the state of charge in pounds per square inch. Table 2 gives the man-hours at given altitudes. Example for use of tables:

Assuming the following conditions:
System . . . . High Pressure
Crew . . . . 4 Men
Cylinders . . . . 1 Type B-1
Altitude . . . . Anticipated flight at 20,000 ft.
Cylinder pressure . . 1480

Table 1 shows that at 1480 psi the high pressure system is .80 charged. Table 2 shows that at 20,000 ft. a full cylinder will give approximately 4.8 man-hours. Then the state of charge times the man-hours (.80 times 4.8) gives approximately 3.84, the hours for one man; divide by 4 gives .96 hours, the duration of supply for four men.

TABLE 1

B-1 CYLINDERS

Internal volume is 295 cu. in.
Free gas capacity, 1800-200 psi, is 19.6 cu. ft.

*High Pressure**	*State of charge*
1800	Full
1480	.80
1160	.60
1000	.50
840	.40
520	.20
200	Empty

*High pressure cylinders charged to 1950 psi will decrease to approximately 1800 psi in cooling.

Cubic foot=28.32 Liters

TABLE 2

OXYGEN CONSUMPTION TABLE FOR B-1 CYLINDER

10.5	man-hours at 10,000 ft.
6.2	man-hours at 15,000 ft.
4.8	man-hours at 20,000 ft.
4.0	man-hours at 25,000 ft.

(3) LOW PRESSURE DEMAND (CREW) OXYGEN DURATION COMPUTATION.—Table 3 gives the state of charge in pounds per square inch. Graph 1 gives the approximate man-hours supply at given pressures and altitudes when a G-1 cylinder and a Type A-12 or an AN6004-1 regulator are used. An example of the procedure to be used in finding the man-hours duration of oxygen is as follows:

Example for use of table and graph
Assuming the following conditions:
System . . . . Low pressure
Regulators . . . . . . Type A12 or AN6004-1,
AUTO-MIX "ON"
Crew . . . . 4 men
Cylinders 5, G-1
Altitude . . . . Anticipated flight at 20,000 ft.
System Pressure . . 330 psi.

Table 3 shows that at 330 psi the low pressure cylinder is .80 changed. Graph 1 (G-1 cylinder and A-12 or AN6004-1, AUTO-MIX "ON") shows that one fully charged cylinder will give approximately 4.75 man-hours at 20,000 feet. Then state of charge times man-hours (.80 times 4.75) gives approximately 3.8 man-hours per cylinder at 20,000 feet. Five cylinders will contain approximately 19 man-hours, or enough oxygen for a crew of 4 men on a 4.75 hour flight, if no excessive use of oxygen is required.

TABLE 3

G-1 Cylinder Internal Volume is 2100 cu. in.
Free Gas Capacity, 400-50 psi, is 29.0 cu. ft.

F-2 Cylinder Internal Volume is 1000 cu. in.
Free Gas Capacity, 400-50 psi, is 13.8 cu. ft.

J-1 Cylinder Internal Volume is 18,000 cu. in.
Free Gas Capacity, 400-50 psi, is 248.0 cu. ft.

*Low Pressure**	*State of Charge*
400	Full
330	.80
260	.60
225	.50
190	.40
120	.20
50	Empty

*Low pressure cylinders charged to 425 psi will decrease to approximately 400 psi in cooling.

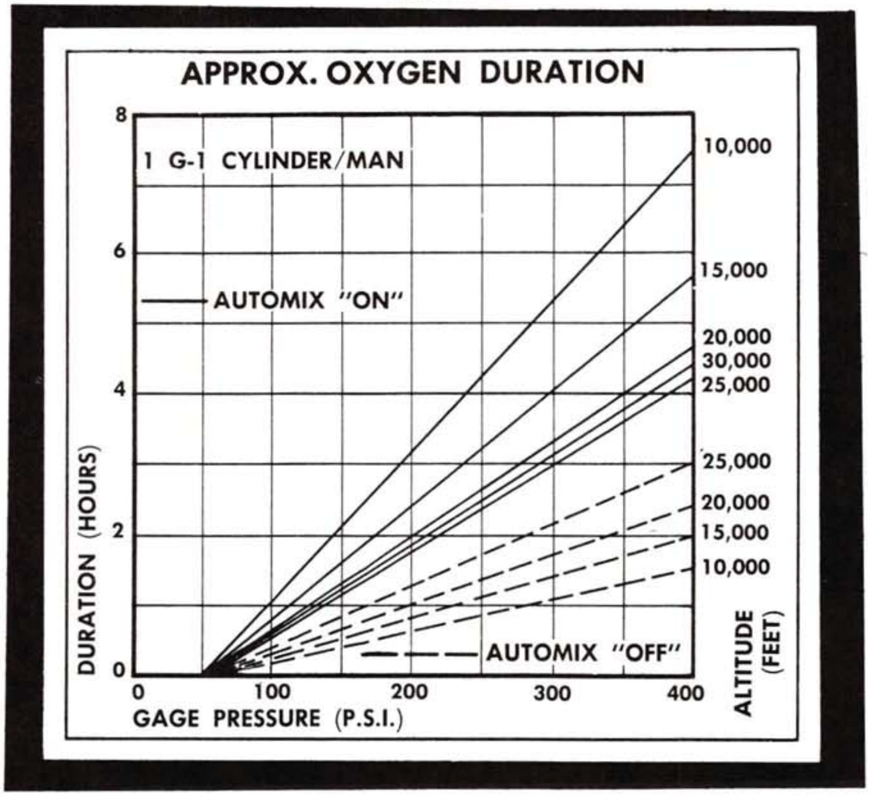
Cubic inch=.0164 Liters

TABLE 4

MAN-HOURS DURATION FOR J-1 CYLINDER

72	man-hours at 10,000 ft.
65.5	man-hours at 15,000 ft.
59	man-hours at 20,000 ft.
54	man-hours at 25,000 ft.
49	man-hours at 30,000 ft.

GRAPH 1



(4) LOW PRESSURE CONSTANT FLOW (TROOP) OXYGEN DURATION COMPUTATION. —Table 3 gives the state of charge in pounds per square inch. Table 4 gives the man-hours at given altitudes.

Example for use of tables:

Assuming the following conditions:

System	Low Pressure
Personnel	10 Men
Cylinders	1 Type J-1
Altitude	Anticipated flight at 20,000 ft.
Cylinder pressure	260 pounds.

Table 3 shows that when a cylinder registers 260 psi it is .60 charged. Table 4 shows that at 20,000 feet a full cylinder will last 59 man-hours. Then the state of charge times the man-hours (.60 times 59) gives approximately 35.4, the hours of supply for one man. Divide by 10 gives 3.54 hours, the duration of supply for ten men.

WARNING

Personnel responsible for the handling of oxygen equipment must read carefully and heed at all times the information, instructions, and precautionary measures as set forth in this section.

g. TEST OF OXYGEN EQUIPMENT.

(1) MATERIALS.

(a) Oxygen—Aviator's Breathing, Army-Navy Specification AN-O-1a. Commercially available.

(b) Thread sealing compound, Army-Navy Specification AN-C-86.

(c) Kelite 2A Bubble Fluid (or equivalent) Test solution to be made by mixing 1 part Kelite 2A Bubble Fluid with 3 parts water.

(d) Portable charging unit of an approved design with manifolding pressure gages and regulator.

(e) Suitable test stands and equipment for functional and leak testing component parts and assemblies.

(f) Indicating or recording master test gages, 0 to 500 psi range, 5 psi graduation, accurate to within 1% of scale.

(2) INSTRUCTIONS.

(a) The following instructions and safety precautions must be understood by personnel before performing any of the specified tests on Oxygen equipment.

1. Oxygen testing shall be done only by assigned personnel in areas devoted exclusively to oxygen testing. No open flame, electric arcs, or other sources of high temperature shall be permitted into the vicinity of the tests.

2. Specification AN-O-1a, Aviator's Breathing Oxygen, shall be used in all function and leak tests of oxygen lines and equipment.

3. Testing of instruments shall be made strictly as specified in this manual. No attempt should be made to repair defective or damaged instruments.

4. When changing instruments at stations in individually manifolded airplanes, the station system oxygen supply may be relieved without losing oxygen in the other individual systems by plugging the British adapter (AAF Drawing No. 42A6950), located in the filler valve box, into the portable recharger unit. This precedure quickly relieves the pressure in the filler lines, thus causing the check valves to separate each individual manifold. The oxygen in the individual system may then be allowed to escape if the emergency valve is opened on the regulator; or the filler adapter may also be used to empty the system by plugging into the recharger unit.

5. Whenever cylinders or any other oxygen instruments are removed from the system, all open ends should be sealed with scotch tape. The use of friction tape should be avoided when possible. After the removal of any tape, the surface must be clean and free of any adhesive.

6. Oxygen lines that are contaminated should not be blown out with air. Remove and wash line or part in accordance with Specification No. 40363-B for cleaning. Rotate tubing to avoid air pockets. Remove and wash in warm water, 120°F. (49°C.). Rinse in a second bath of warm water. Dry in an oven at 180°F. to 200°F. (82°C. to 93°C.). Lines must not be left uncapped.

7. Fittings that are contaminated should be cleaned as specified in *6.* preceding.

8. All brass or bronze male pipe threads must be treated with AN-C-86 compound. It must also be used on aluminum and magnesium alloy straight threads and the shoulder of AN-819 sleeves if seizing is experienced.

9. Care must be exercised in applying thread lubricant to avoid any compound entering the system. A uniform even coating of compound should be applied to male threads with a small, stiff brush. Rectorseal when applied on straight thread fittings must not be applied on lead thread; on pipe threads, however, it should be applied on the first 3 threads.

Note

If compound is applied excessively, it may be forced into the system and cause improper function of the equipment.

(3) TEST OF DEMAND (CREW) SYSTEM.

(a) Test by connecting to the line system forward of the cylinders, carefully bring pressure in each of the two respective demand systems (Pilot's and Co-Pilot's) up to 110 psi, as indicated on master gages which have been plugged into Pilot's and Co-pilot's systems, at the portable recharger connections. Check all indicator lights for "OFF." Bleed pressure in each system to 90 psi through regulator "EMERGENCY ON" valves and check lights for "ON." Replace defective switches.

(b) Bleed dust from breather hoses by holding dust cap open and carefully opening "EMERGENCY ON" valve for 10 to 20 seconds.

(c) Test each regulator and blinker by placing control "AUTO-MIX" lever in the "OFF" position and breathing through hose using a demand mask if possible. Observe blinker operation and replace inoperative blinkers.

(d) Increase pressure in lines system to 450 psi as indicated on master gages.

(e) Bubble check all connections, valves, and fittings.

(f) Repair all leaks and re-check repaired joints with Bubble Fluid. When no leaks are apparent by bubble check, the following method should be used as a final leak test:

1. The entire oxygen system, including cylinders, shall be charged to 450 psi at a rate not exceeding 25 psi per minute. After one hour the airplane temperature and time shall be recorded and entered on the inspection card. The oxygen pressure shall be checked again before flight. If more than 4 psi for each 6 hour period (15 psi for each 24-hour period) has been lost after correction for temperature change as shown on temperature correction chart, the system must be reworked and given additional leak check. Flight pressure shall be 425 ± 25 psi.

(4) TEST OF CONSTANT FLOW (TROOP) SYSTEM.

(a) FUNCTION TEST.

1. Close valve on constant flow oxygen filler line. Remove plug in hose connection provided for J-1 cylinder and attach a filler valve and master gage unit.

2. Charge the constant flow oxygen filler and supply line from this point through the attached recharger unit to 450 psi.

Note

Pressure must remain above 100 psi on inlet side of A-11 regulators during the function and leak test of automatic couplings.

3. Fill constant flow oxygen leak tester assembly, A.A.F. Drawing No. 44B 10627, to a maximum of 35 psi and plug leak tester hose into an automatic coupling on the constant flow outlet manifold. Open valve on leak tester and allow pressure to equalize itself between leak tester cylinder and constant flow manifold so that the final pressure is between 25 and 30 psi.

4. With the pressure on constant flow manifold between 25 and 30 psi, a spare mask plug should be pressed momentarily into each automatic coupling to test for free movement of valve core and for free flow of oxygen through restricted orifice in the automatic couplings. Where there is evidence of line blockage or sticking of valve core, the manifold block in question must be rejected and handled in the usual manner.

(b) LEAK TEST.

1. After function test, disconnect leak tester hose coupling from automatic coupling and recharge leak tester assembly to approximately 35 psi. Recharge constant flow system manifold with leak tester by plugging into constant flow outlet coupling as described in paragraph (3) under Function Test above. In order to prevent damage on A-11 Regulators, back pressure against outlet side of Regulator must not exceed 30 psi.

2. After a five minute pressure equalization period, observe the reading on leak tester gage, which must be between 25 and 30 psi. There shall be no drop in pressure during a period of fifteen additional minutes.

3. The reading on master gage, plugged into constant flow oxygen line system at the J-1 cylinder connection, must be 425 ± 25 psi after a minimum of five minutes for pressure level-off and should be recorded at the same time as the gage reading on constant flow leak tester No. 44B 10627 described in paragraph 2 above. There shall be no drop in pressure for this portion of constant flow system during a period of 15 additional minutes.

4. When J-1 cylinders are installed, the leak test of the constant flow system may be included in the test of the entire oxygen system as described in paragraph *g.*(3)*(f)* preceding.

TROUBLE SHOOTING LOW PRESSURE DEMAND AND CONSTANT FLOW OXYGEN SYSTEMS

Trouble	*Probable Cause*	*Remedy*
PRESSURE IN SYSTEM FAILS TO SHOW INCREASE WHEN THE SYSTEM IS FULLY CHARGED TO 425 ± 25 psi.	Flaw in the pressure gage.	Remove and replace.
	Wrong installation of check valves.	Remove and reinstall so that arrows point in direction of flow.
REGULATOR FAILS TO RELEASE OXYGEN.	Clogging of orifices by ice which forms due to moisture in system during altitude flights.	Purge system with dry oxygen and refill using Specification AN-O-1a.
	Clogged orifices due to thread compound or other contamination.	Remove and replace.
	Diaphragm has been blown out of shape.	Remove regulator and replace.
PRESSURE DROPS ACUTELY.	Leak in portable recharger, check valves, connections, tubing, or regulator.	Soap check and replace defective items.
	Drop in outside temperature.	See temperature correction chart, paragraph 20.*e*.
FLOW INDICATOR FAILS TO BLINK WHEN USER IS BREATHING INTO THE HOSE WITH THE AUTO-MIX "OFF."	Emergency valve may be turned on.	Turn emergency valve off and check flow indicator.
	Defect in mechanism.	Remove and replace.
DEMAND VALVES FAIL TO CLOSE AFTER BREATHING (OXYGEN FLOW CONTINUES).	Defective demand valves in regulator.	Remove and replace.
ON CONSTANT FLOW SYSTEM — INSUFFICIENT FLOW AT AUTOMATIC COUPLING WHEN MANIFOLD IS AT 15 TO 25 POUNDS PRESSURE.	Foreign matter in restricted orifice.	Remove coupling and replace.
	Defective valve core.	Remove coupling and replace.
	Failure of A-11 regulator.	Remove regulator and replace.
LEAKS IN LINES AND FITTINGS.	Improper alignment of tubes and fittings.	Bring tubing and fitting into proper alignment.
	Cracked or rough flare.	Reflare line or replace.
	Damaged or defective fittings.	Remove fitting and replace.

21. FIRE DETECTION SYSTEM.

a. DESCRIPTION.—A fire detection system is used to warn the crew whenever a fire exists in either power package. The system has a thermocouple type circuit for detecting fire in each of the power packages. The system has two individual warning lights installed on the pilot's instrument panel. Whenever either of the individual detector circuits detects fire, the individual fire warning light for that circuit operates.

b. RESISTANCE CHECK.—Check the circuit resistance of each detector circuit. Remove the detector circuit connector from the relay panel. In the plug portion of the connector, successively connect an accurate low scale ohmmeter across sockets "A" and "B" to check resistance of No. 1 detector circuit in left-hand engine section, and "C" and "D" to check resistance of No. 2 detector circuit in right-hand engine section. The resistance of any one circuit must not exceed six ohms. Accurate resistance measurements may be made only when the thermocouple circuit is at thermal equilibrium. This is easily checked by reversing the leads of the ohmmeter. If the reading does not change with the reversing of the leads the system is in equilibrium and the measurement may be considered accurate. If reading does change, allow system to cool before proceeding with resistance check.

c. GROUND TEST.—Check each detector circuit for freedom from grounds. Connect an ohmmeter from either socket "A" or "B" of detector circuit connector to ground and from either "C" or "D" to ground. The resistance in each case must not be less than 5000 ohms.

d. POLARITY TEST.—Check circuit for thermocouple polarity using a milliammeter, millivoltmeter, or the lowest range in the standard d-c volt-ohm milliammeter. Connect the positive (plus, meter lead to the "A" socket and the negative (minus) meter lead to the "B" socket of the selector circuit connector to check No. 1 detector circuit in left-hand engine section and connect the positive meter lead to the "C" socket and the negative meter lead to the "D" socket to check No. 2 detector circuit in right-hand engine section. Successively heat the thermocouples by means of a soldering iron. (To obtain maximum heat, touch tip of soldering iron to top of thermocouple. Be careful not to touch both tip and shell of thermocouple with soldering iron, as this will ground thermocouple.) Meter deflection should be clockwise. The need for polarity check cannot be overstressed since the output from one or a group of reversed thermocouples will not only fail to operate the system, but will tend to counteract the output of the other thermocouples.

e. GENERAL PERFORMANCE TEST.—Connect a 28-volt source of power and energize system by activating test switch. With switch held in 10 seconds or less, both warning lights should come in.

f. DETECTOR CIRCUIT TEST.—If above test proves the system to be defective, disconnect detector circuit connector from relay panel. In its place, insert a connector, part No. AN3108-14S5S, whose A-B and C-D pins have been shorted together. (If above connector is not available, short pins together, using best available method.) Operate test switch. If an alarm now results, the detector circuit is the defective portion of the system.

g. OPEN CIRCUIT TEST.—After determining that the detector circuit is open, connect an ohmmeter from either socket of the connector of the defective circuit to ground in the airframe. Then successively short each thermocouple to ground by inserting a jumper wire from tip of thermocouple to ground. When two adjoining detectors are located, of which only one gives continuity to ground, the open circuit is between the two.

h. ALARM CIRCUIT TEST.—Remove the alarm circuit connector from the relay panel and short sockets "A," "B," and "C" together in the connector. Operate the test switch. Lack of response by any individual warning signal indicates trouble in that particular circuit while lack of all response shows a defective test circuit.

SECTION V

USEFUL OR MILITARY LOAD INSTALLATION

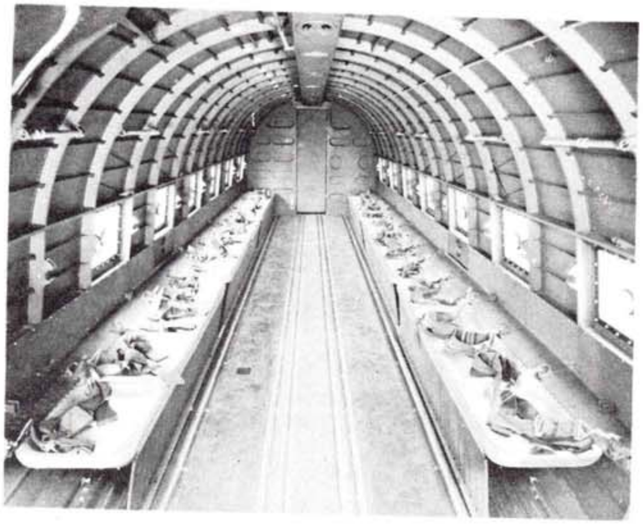


Figure 589—Cabin Interior—Seats Installed

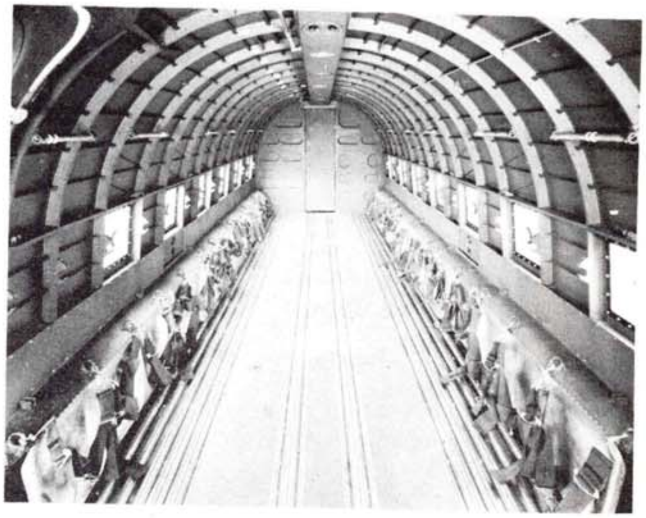


Figure 590—Cabin Interior—Seats Stowed

1. TRANSPORT AND CARGO PROVISIONS.

a. TRANSPORT PROVISIONS.

(1) TROOP ACCOMMODATIONS. – Folding benches are installed along each side of the cargo compartment, providing accommodations for 28 troops or other personnel. (See figure 589.) The benches may be folded down against the sides of the cargo compartment when not in use and serve to protect the fuselage structure against damage when in this position. (See figure 590.) There are 28 safety belts installed in the fittings on the bench support beams. In some airplanes, a single seat has been removed from the aft seat section just forward of the main cargo door to allow more room for the jumpmaster at the parapack release control box.

(a) STATIC LINE.—The static line consists of a 7 x 19 extra flexible steel cable, a turnbuckle assembly, and two attaching fittings. The fittings are located in the top of the cargo compartment. The forward fitting is attached to an intercostal at the top of the cargo compartment near the forward bulkhead. The aft fitting is attached to the top of the first frame forward of the lavatory door. The static line is further supported by a fair-lead in a web attached to the third frame forward of the lavatory door. Four spring clips are located directly above the line. When not in use, the line may be snapped into these clips and stowed out of the way. The turnbuckle assembly enables the tension of the line to be adjusted. A sag of 7 inches should be maintained.

1. AAF TYPE STATIC LINE. – The AAF type static line, with which the ship is equipped, is located at the top of the cargo compartment to the left of the center line of the airplane.

2. BRITISH-TYPE STATIC LINE.—Fittings are also provided for installation of the British-type static line. The same cable is utilized, but it is removed from the overhead attaching fittings and connected to the fittings on the right-hand side of the cargo compartment. The forward fitting for attaching the British-type static line is located on the first frame forward of the first window on the right-hand side of the fuselage and is even with the top of the window. The aft fitting is attached to the third frame forward of the aft bulkhead, directly opposite the cargo loading door.

(b) SKIDPROOF FLOOR. – Skidproof floor panels, shipped with the airplane as loose items, are provided for use by the paratroops to assure a safe footing when using the aisle. The complete floor consists of seven panels, attaching screws, and anchor nuts. Three of the smaller panels are installed in the aisle directly in front of each row of benches and the larger panel is installed opposite the jump door. These panels may be installed by removing the present panels and substituting the skidproof floor panels.

Note

This flooring must be removed before loading cargo, as it is not designed to handle any loads greater than will be applied by the paratroops.

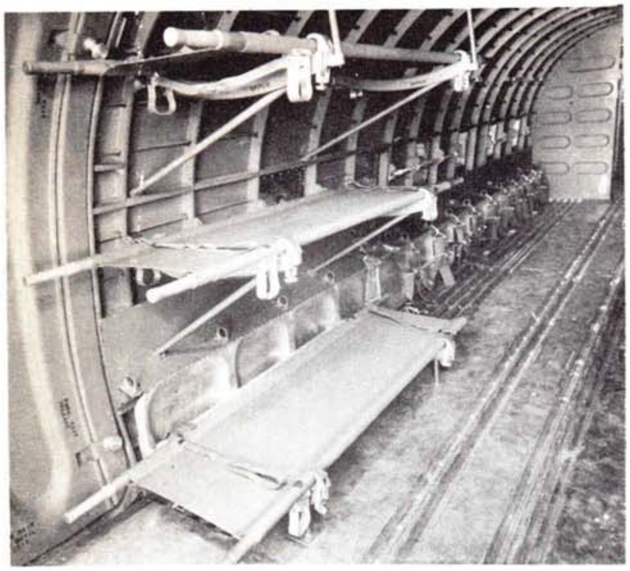


Figure 591—Litter Arrangement

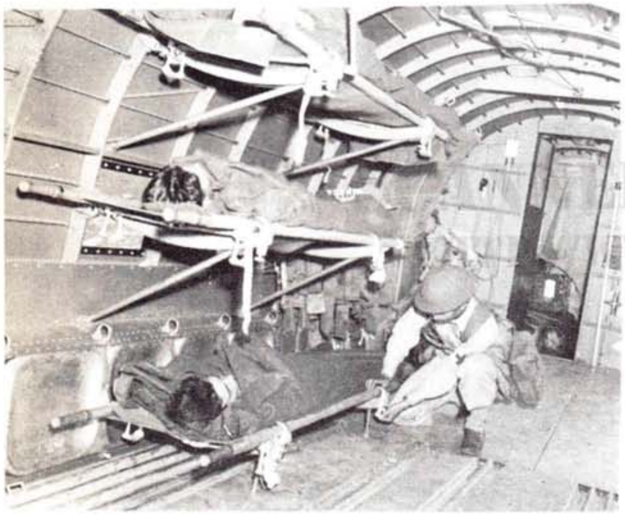


Figure 592—Hospital Arrangement

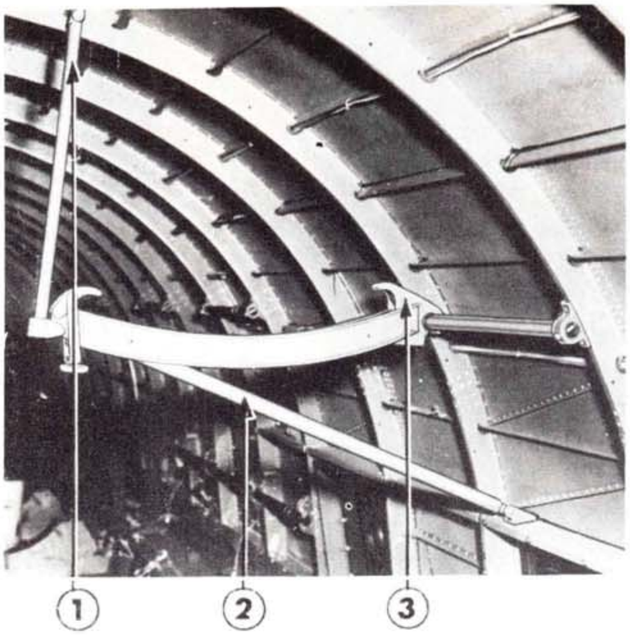


Figure 593—Upper Litter Support

1. Upper Tube Support
2. Lower Tube Support
3. Litter Support Hooked in Place

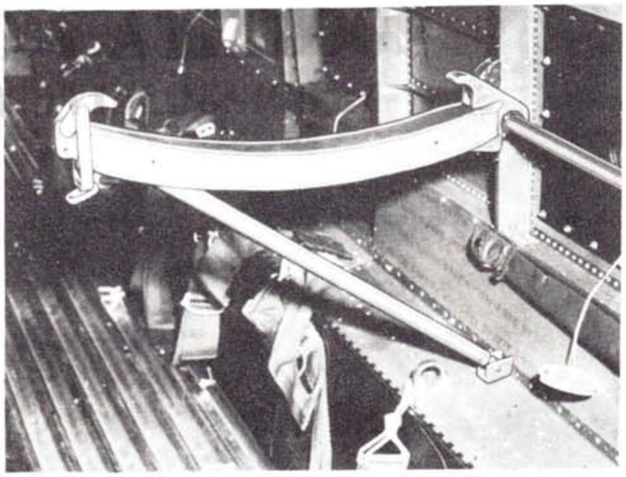


Figure 594—Middle Litter Support

b. HOSPITAL ACCOMMODATIONS.

(1) METAL TYPE LITTER SUPPORTS. *(See figure 592.)*

(a) DESCRIPTION.—Attach fittings for the installation of 18 sets of litters are provided inside the cargo compartment. The brackets for the attaching of the litter supports are located on the frames on each side of the cargo compartment even with the center line of the windows. Other fittings are mounted between the frames near the top line of the windows and tube-type supports are installed between these same frames halfway up the sides of the fuselage. Attachments for the upper litter supports are secured to support channels on the left and right of the center line of the airplane near the top of the cargo compartment. Support attach brackets are located on the seat support beams. The litters are mounted in three tiers of three litters each, on both sides of the cargo compartment. (See figures 591 and 592.) The six lower litters are attached to the floor and are adjustable from a horizontal to a 20-degree inclined position. When a litter is in the inclined position, the intermediate litter directly above cannot be used as there will be insufficient clearance. The eighteen sets of litter supports are carried in red fibre boxes stowed beneath the aft end of the main cargo compartment floor, and are easily accessible by removing all screws from the center floor panel and raising the floor. The supports are installed into the fittings provided on the sides of the main cargo compartment and the litters are placed upon these supports. (See figure 591.)

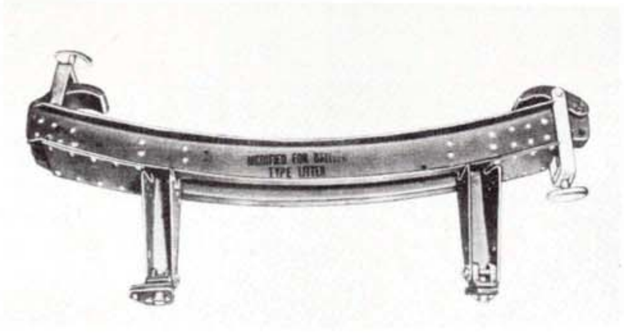


Figure 595—Lower Litter Support (Unmounted)

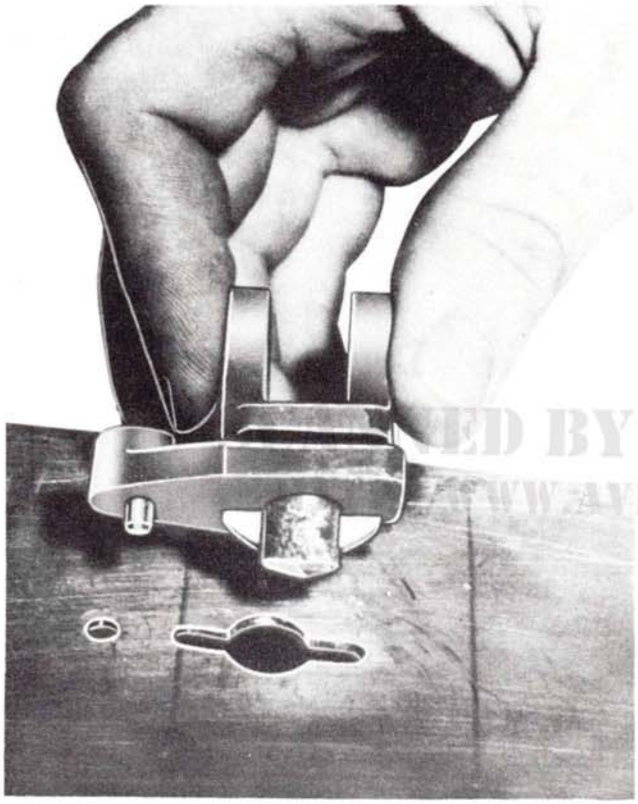


Figure 596—Installing Clevis Type Fitting in Floor Cut-Out

(b) INSTALLATION.

1. Remove the floor panel from the cargo loading floor opposite the cargo loading doors and take the litter supports from their stowage place.

2. Attach the tube support (1, figure 593) to the attach fitting near the top of the cargo compartment.

3. Connect another tube support (2, figure 593) to the second fitting above the seat beam.

4. Install the litter support into the third fitting above the seat beam by hooking the end of the litter support over the tube support already installed at this location. (See 3, figure 593.)

5. Swing the litter support up to a horizontal position and connect the lower tube support (2, figure 593) into the forward side of the litter support, attaching the tube support to the first bolt in the lower row of three bolts on the inboard end of the litter support. This holds the litter support in the level horizontal position.

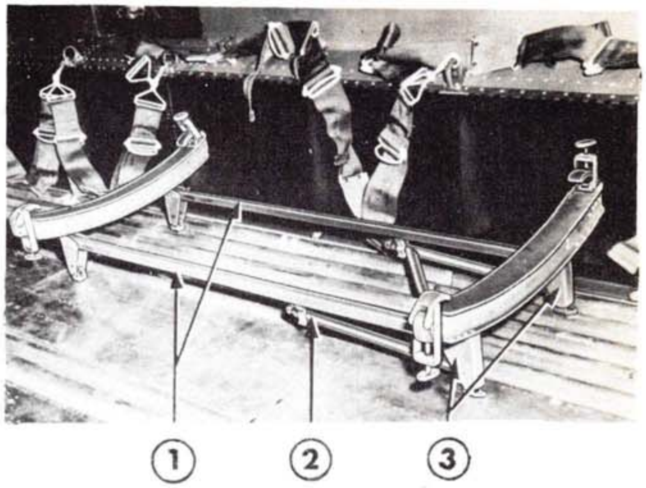


Figure 597—Lower Litter Support Installed

1. Square Tube Braces
2. "Z" Support in Stowed Position
3. Leg Brackets Installed in Floor

6. Attach the tube support (1, figure 593), which is attached to the fitting at the top of the fuselage, into the bottom bolt on the extreme inboard end of the litter support.

7. Attach a tube support (figure 594) into the fitting located on the seat beam.

8. Connect the litter support into the first fitting above the seat beam fitting by hooking the end of the litter support over the tube support already installed at this location. (See figure 594.)

9. Lift the litter support to a horizontal position and connect the tube support into the first bolt on the lower row of three bolts on the inboard end of the litter support. The tube support should be secured to the forward side of the litter support. (See figure 594.)

Note

The lower litter is so designed that it may be raised to an inclined position. If it is intended to use this litter in the inclined position, the middle litter (just installed) cannot be used, as there will not be sufficient clearance.

10. INSTALLING THE LOWER INCLINED LITTER.

a. The lower litters rest on litter supports which have brackets that act as "legs" bolted to the under side. A clevis-type fitting is secured to the bottom of each of the two "legs" with a pin which is safetied. (See figure 595.)

b. Detach one of the clevis-type fittings from the "leg" of the litter support by removing the safety and the pin.

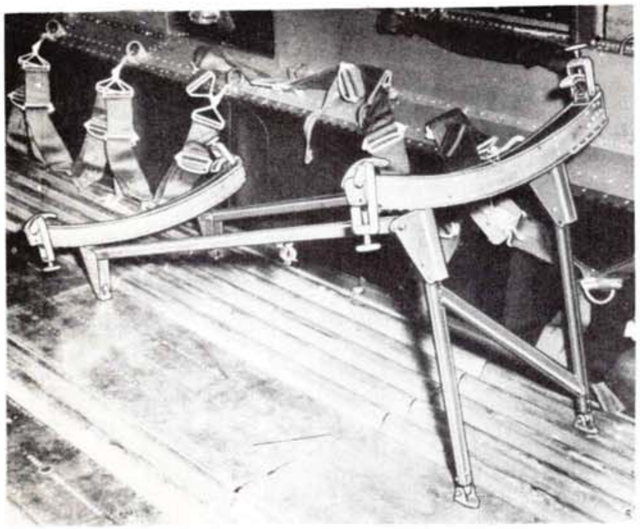


Figure 598—Lower Litter Support—Inclined Position

c. Install the clevis-type fitting into the slotted cut-out.

d. Take the litter support with one clevis-type fitting attached and install the clevis fitting into the slotted cut-out located on the corrugated floor. This slotted cut-out is located just in front of the seats when the seats are in the stowed position (3, figure 597).

e. Connect the litter support into the clevis-type fitting previously installed in the floor panel by slipping the "leg" of the litter support over the fitting and replacing the pin and safety (3, figure 597).

f. Install another lower litter support in the same way to the next fitting location aft.

g. Connect the two lower litter supports by using the long square tubes which are provided and connecting the tubes to the "legs" of the forward lower litter support and the "legs" of the aft lower litter support (1, figure 597). Use AN4-15A bolts and AC365-428 nuts for this connection.

h. Attach the "Z" support to the "legs" of the lower litter support by placing the round ends of the "Z" support into the "leg" brackets and attaching through the first hole above the floor fittings with AN4-15A bolts and AC365-428 nuts.

i. Swing the "Z" support up and into the clips on the square connecting tubes. This stows the "Z" support out of the way. (See 2, figure 597.)

11. RAISING THE LOWER LITTER INTO THE INCLINED POSITION.

a. Remove the safety and the pin from the floor clevis-type fittings.

b. Raise the end of the litter.

c. Place the tongue ends of the "Z" support into the floor fittings and replace the pin and the safety. (See figure 598.)

12. REMAINING LITTER SUPPORTS.—

Install the remaining litter supports in the same way, using the procedure outlined above in paragraphs 1.*b*.(2)*(j)1*. through *9*., and *(k)1*. through *3*.

(c) MAINTENANCE AND REPAIR OR REPLACEMENT.

1. Inspect all tube supports for cracks or wear, especially around the points where the tubes attach to the fittings.

2. Replace all worn or damaged parts.

3. The support brackets or "legs" on the lower litter support may become bent. These supports should be straightened and aligned so that they fit properly into the floor fitting.

(2) STRAP-TYPE LITTER SUPPORTS.

(a) DESCRIPTION.—On some airplanes provisions are made for installing strap-type litter supports in place of the metal supports described in the preceding paragraphs. Four litters may be mounted in a tier when this installation is used, making it possible for the airplane to carry 24 litters instead of 18. The strap-type supports (figure 599), consist of adjustable web straps, buckle assemblies, and adjustable loops within the straps for supporting the litter handles. The supports for the outboard handles of the litters consist of a buckle and strap assembly mounted on channels which are attached between the frames along the sides of the cargo compartment. The inboard handles of the litters are supported by the adjustable loops in the long inboard straps. These straps are suspended from hangers (2, figure 600), which are attached to channels between the frames along the top of the cargo compartment, and snap into rings along the cargo compartment floor. (See figure 601.) An adjusting buckle (1, figure 600), is provided on both the inboard straps and the outboard buckle assemblies. This enables the loops to be tightened so that a firm grip on the litter handles is assured. The tension on the inboard straps may be adjusted by using the adjusting buckle. (See 3, figure 600.) The outboard buckle assemblies which are attached to the channels between the frames remain mounted in the airplane when the litter installation is not being used, and the inboard straps remain attached to the hangers (2, figure 600). Canvas bags, marked "LITTER STRAP STOWAGE," are snapped to the longerons near the strap hangers. The inboard straps may be unsnapped from the floor rings (figure 601), rolled, and stowed in these bags.

(b) INSTALLATION.

1. Take the inboard straps from the stowage bags, unroll the straps and snap the straps to the proper floor ring. (See figure 601.)

2. Starting at the forward end of the cargo compartment, install the litters by putting the litter handles through the loops in the strap assemblies. Secure the outboard litter handles to the buckle and strap assemblies on the cargo compartment walls.

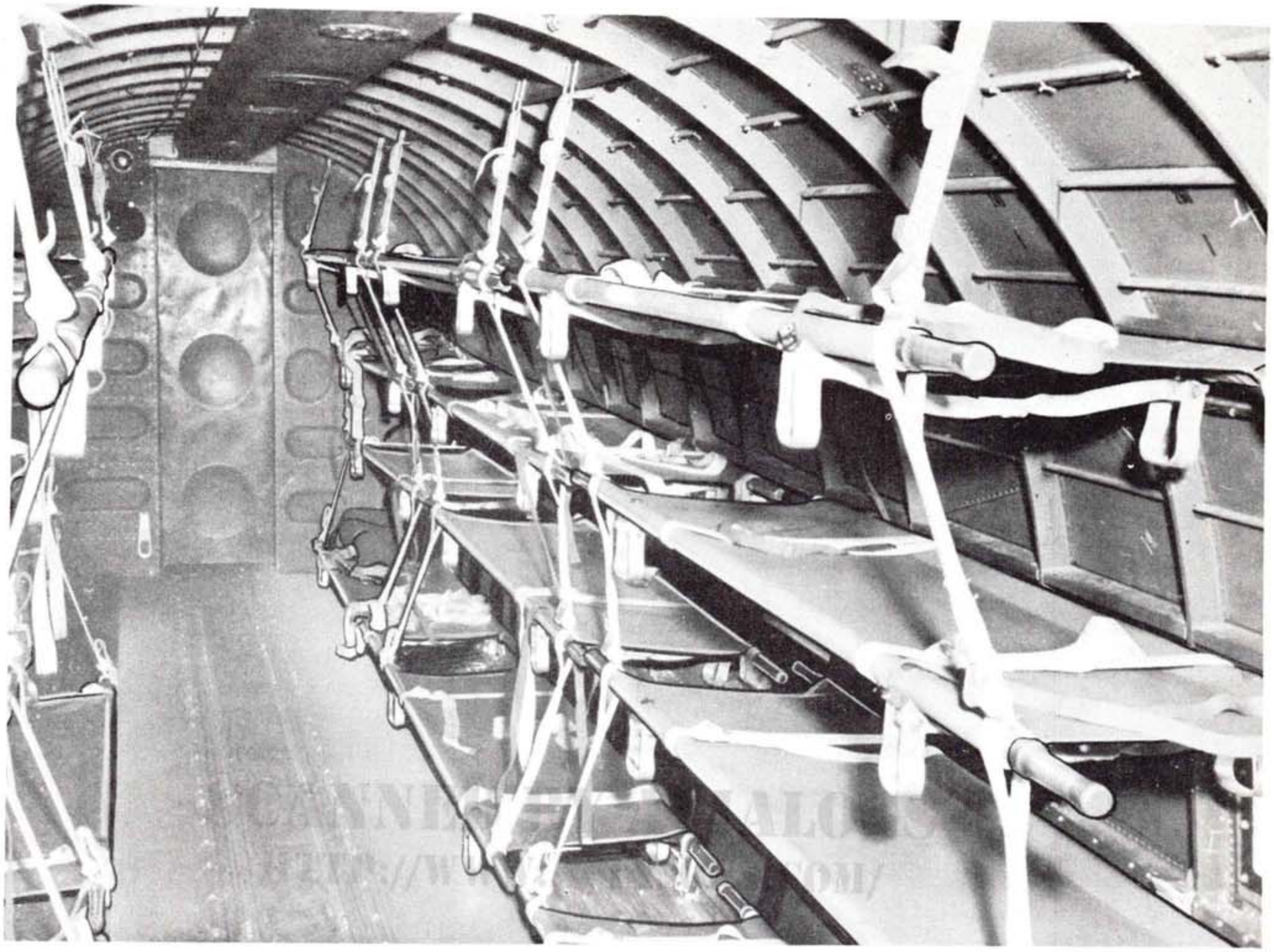


Figure 599—Strap Type Litter Supports Installed

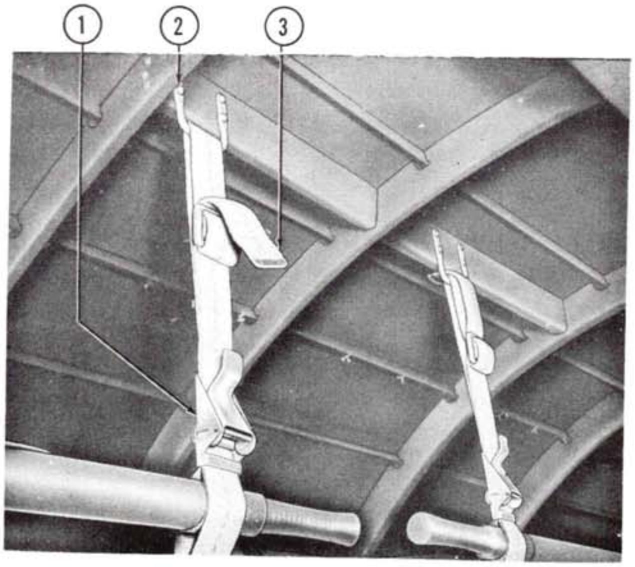


Figure 600—Litter Strap Attachment at Top of Cargo Compartment

1. Adjusting Buckle for Litter Support Loop
2. Hanger
3. Strap Tension Adjustment Buckle

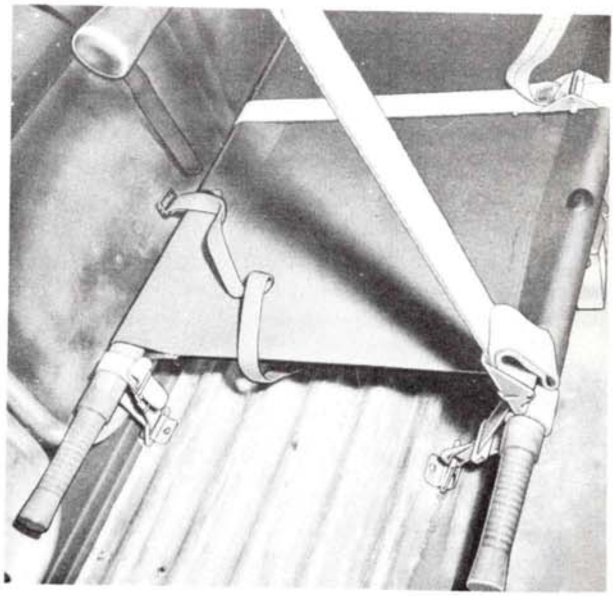


Figure 601—Litter Support Floor Attachment

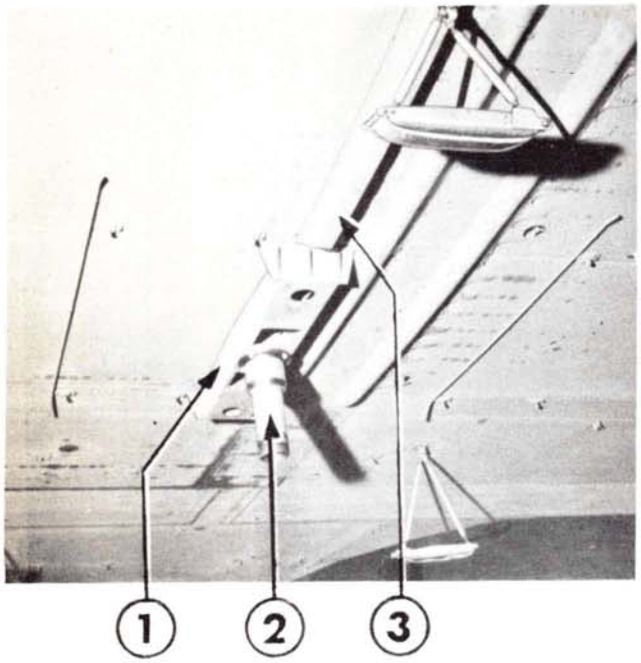


Figure 602—Forward Supports for Three-Blade Propeller

1. Shaft Adapter Support
2. Shaft Adapter
3. Channel Support (Furnished as Loose Item)

3. Adjust the handle support loops as tightly as possible, using the adjusting buckle (1, figure 600).

4. Using the strap buckle (3, figure 600), adjust the inboard strap tension.

Note

When adjusting the inboard straps, raise the inboard side of the litter slightly so that when adjusted the litters slant toward the wall. This is a safety measure to prevent the patient from rolling out of the litter.

(c) INCLINING A LITTER USING STRAP TYPE SUPPORTS.—The bottom, or floor row of litters may be inclined when the strap-type support installation is used.

1. Loosen the straps and remove the litter immediately above the floor litter.

2. Remove the handle support loops from one end of the litter which is to be inclined.

3. Incline the litter by raising the free end.

4. Secure the handles of the raised litter by inserting the handles in the next highest row of support loops. That is, the raised end of the litter will be secured by the loops that supported the litter removed in step *1.*

5. Adjust all straps.

(d) REMOVAL.

1. Loosen the handle support loops (1, figure 600), and remove the litters.

2. Unsnap the inboard strap assemblies from the floor rings (figure 601).

3. Roll the straps and stow them in the canvas bags provided.

4. If it is necessary that the buckle assemblies along the side of the cargo compartment be removed, remove them by taking out the four screws in the mounting bracket.

c. PROPELLER TRANSPORTING EQUIPMENT.

(1) DESCRIPTION.—Special fittings are provided beneath the fuselage for transporting two three-bladed or two four-bladed propellers (or a combination of one of each), ranging in diameter from 10 to 17 feet. The installation provides for carrying one propeller beneath the center wing section and one beneath the fuselage slightly forward of the cargo loading door. Three support channels are included in the miscellaneous equipment of each airplane. These channels serve as attach fittings for the propeller blade supports when the propeller is carried at the forward location (3, figure 602).

(2) INSTALLATION.

(a) MOUNTING A THREE-BLADED PROPELLER AT THE FORWARD LOCATION. *(See figure 602.)*

1. Remove four screws from the forward spar of the center wing section at a point approximately 18 inches to the left of the center line of the airplane (looking aft). The screws are indicated by a heavy black line and are plainly stenciled "3 BLADE PROP ATTACH SCREWS." Remove four screws, located and marked as above, from the center spar of the center wing section. (See figure 606.) Bolt the support channel (3, figure 602) into these attach points with eight AN 3-10A bolts, four places at each end of the support channel.

2. Attach the support (1, figure 602) at the point where the propeller hub will center by removing four screws from the forward attach point on the rear of the center spar of the center wing section approximately one foot to the left of the center line of the airplane (looking aft). This attach point is plainly marked with a heavy black line and the stenciled words "PROP ATTACH SCREWS." Remove the four screws from the aft attach point located on the forward edge of the rear spar of the center wing section. This attach point is approximately one foot to the left of the center line of the airplane and is marked and stenciled as above. (See figure 606.) Bolt the support (1, figure 602) into these attach points with eight AN 3-6A bolts, four at each end of the support. The support must be drilled to match nut plates built into the spar caps where screws were removed. Drill the support with size No. 40 drill and then ream out with size No. 10 drill.

3. Bolt the shaft adapter (2, figure 602) to the support. The shaft of the adapter fits into the propeller hub. Shaft sizes, Nos. 40, 50, and 60 are available to fit the corresponding diameters of propeller hubs. They are numbered as follows:

41G5368	No. 40	Shaft Adapter
41G5369	No. 50	Shaft Adapter
41G5367-1	No. 60	Shaft Adapter

In addition to the shaft adapter, the following parts must be provided for this assembly:

AN 5-10 Bolt	8 req
AN 310-5 Nut	8 req
AN 38-2-2 Cotter	8 req

4. Remove the three screws (two places) at the designated stencil points located along the rear spar approximately 3 feet to the left, and right of the center line of the airplane and in line with the access hole cover marked "BELL CRANK." These two attach points are marked "3 BLADE PROP ATTACH SCREWS." (See figure 606.)

5. The following fittings, clamp assemblies, and their attaching parts, are to be installed to suit propellers carried. These fittings are used to support the propeller blades and are attached in three places, one to the forward support channel and two to the attach points on the rear spar (figures 602 and 603).

AN 3-5A	Bolts	
41D488	Clamp Assembly	Width of propeller blade determines dash number used
41D488-2	Clamp Assembly	
41D488-3	Clamp Assembly	
41D488-4	Clamp Assembly	
41B989-2	Support	
X44B164-1	Support Assembly	
X44B164-2	Support Assembly	
41B989-1	Support	

6. Grease all internal parts of the propeller that come into contact with the shaft adapter with a nonoxide grease. Slide the propeller collar shaft bushing over the adapter. Lift the propeller into place and secure it by installing the propeller collar nut over the end of the adapter. Install a dustproof cap over the propeller gear.

7. Fasten the clamp assemblies (figure 603) to the propeller blades.

8. Tighten all bolts and fittings.

(b) MOUNTING A FOUR-BLADED PROPELLER AT THE FORWARD STATION. *(See figure 604.)*

1. A four-bladed propeller is mounted in the same way as the three-bladed propeller with the following exceptions:

a. Remove four screws from the attach point approximately 5 feet to the right of the center line of the airplane and located between and just aft of the two access hole covers marked "TANK SELECTOR VALVE COVER" and "BATTERY CART RECEPTACLE ADAPTER." The attach point screws are indicated by a heavy line and are marked "4 BLADE PROP ATTACH SCREWS." (See figure 606.) Remove four screws from the attach points located in a similar position approximately 5 feet to the left of the center line of the airplane. All these attach points are marked with a heavy black line and are plainly stenciled "4 BLADE PROP ATTACH SCREWS." (See figure 606.)

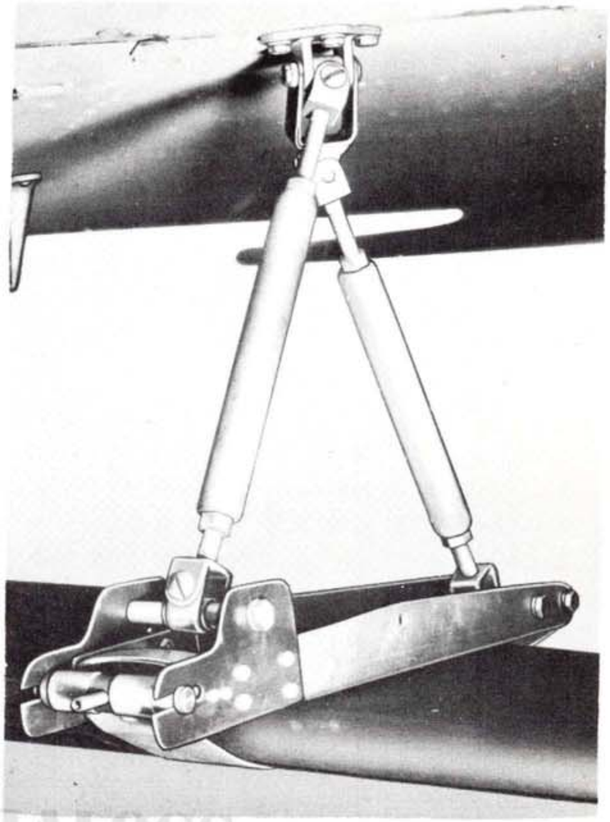


Figure 603—Propeller Blade Support

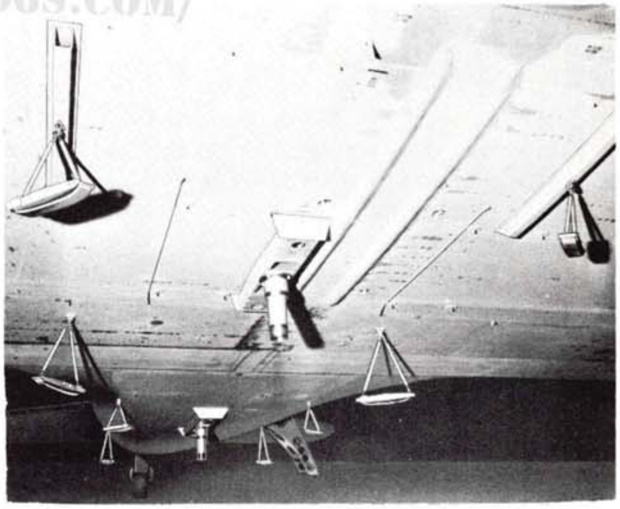


Figure 604—Fore and Aft Supports for Two Four-Blade Propellers

SCANNED BY AVIALOGS HTTP://WWW.AVIALOGS.COM/

b. Bolt the two support channels (figure 597) into each of these attach points with eight AN 3-7A bolts, four to each end of each support.

(c) MOUNTING A THREE-BLADED PROPELLER AT THE AFT STATION.

1. A three-bladed propeller is mounted at the aft station in much the same way that a three-bladed propeller is mounted at the forward station, except that three screws must be removed from the left and right side of the bottom of the fuselage at the stenciled points (two places) on a line just forward of the main cargo loading door. Remove four screws from the attach point on the bottom of the fuselage near the center line of the airplane approximately in line with the cargo compartment aft window. Remove four screws from the other attach point directly aft of this, near the forward light in the group of three recognition lights. Both attach points are marked with a heavy black line and stenciled "PROP ATTACH SCREWS." (See figure 606.)

2. Attach the shaft adapter support at the two attach points from which the four screws were removed.

3. Remove the three screws from the stenciled point near the center recognition light. The propeller blade support attaches at this point.

(d) MOUNTING A FOUR-BLADED PROPELLER AT THE AFT STATION.

(See figure 604.)

1. A four-bladed propeller is mounted at the aft station in the same manner as a three-bladed propeller is mounted at the aft station, except that there are four stenciled points where the propeller blade supports are to be attached. Two of these attachment points are located on the bottom of the fuselage near the point where the wing fillet attaches to the fuselage, and two are located near the front of the cargo loading door. All four points are approximately 4 feet on either side of the center line of the airplane. The channel supports, which are shipped with the airplane as loose items, are not used when installing propeller carrying equipment at the aft location, as the propeller blade supports are bolted directly into the fuselage structure.

Note

> The propeller dome must be carried inside the airplane and not installed on the spare propeller. The blades must be feathered so that they are in a position parallel with the bottom of the fuselage. The trailing antenna is not to be used while the forward three-bladed propeller is in position.

d. PARACHUTE PACK PROVISIONS.

(See figure 605.)

(1) DESCRIPTION.—The parachute pack mechanism consists of six parachute pack containers, attaching fittings, release mechanism, and release controls. The parachute pack racks are located opposite each other beneath the fuselage, three on either side of the airplane center line and are attached with bolts to attach fittings and built-in tube supports. (See figure 605.) Four racks are attached to the bottom of the center wing and two racks are attached to the fuselage belly aft of the wing flaps. One type B-7 bomb shackle installed in each rack provides the pack attaching and releasing mechanism. The shackle is supported on two hooks mounted at the ends of two levers which are swung up to the loaded position by the means of a detachable hand crank. The parachute pack racks and the attaching fittings are stowed in the cargo compartment of the airplane as loose equipment.

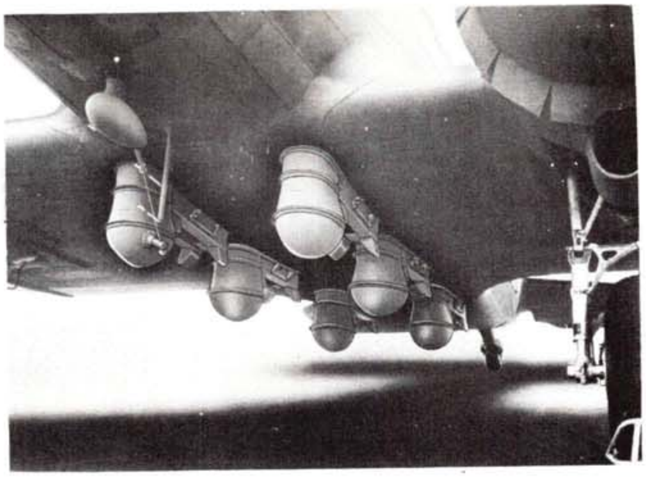


Figure 605—Parapack Racks Installed

(a) ATTACH FITTINGS.—The attach fittings and tube support attach points are located in groups of two, approximately 18 inches to the right and left of the center line of the airplane. The attach fittings are small metal brackets and are easily distinguished by the small bolt that hangs loosely in each fitting. The tube supports are in line with the fittings. They protrude approximately 1/4 inch through the skin of the airplane and are tapped to accommodate the attaching bolt. The tapped hole is covered by a small plug-in type dust cap which may be removed by prying. (See figure 606.)

1. FORWARD PARACHUTE PACK RACKS. *(See figure 605.)*—The forward end of each of the two forward racks is secured by two bolts to the two fittings located on the center wing front beam. The aft end is secured by two bolts to the next two fittings located on the center wing center beam, directly aft of the forward fittings. *(See figure 606.)*

2. CENTER PARACHUTE PACK RACKS. *(See figure 605.)*—The forward end of each of the two center racks is secured by two bolts to two fittings located on the center wing rear beam directly aft of the forward fittings. The aft end is secured by two bolts to the two built-in tube supports located just forward of the center wing flap hinge and in line with the forward fittings. (See figure 606.)

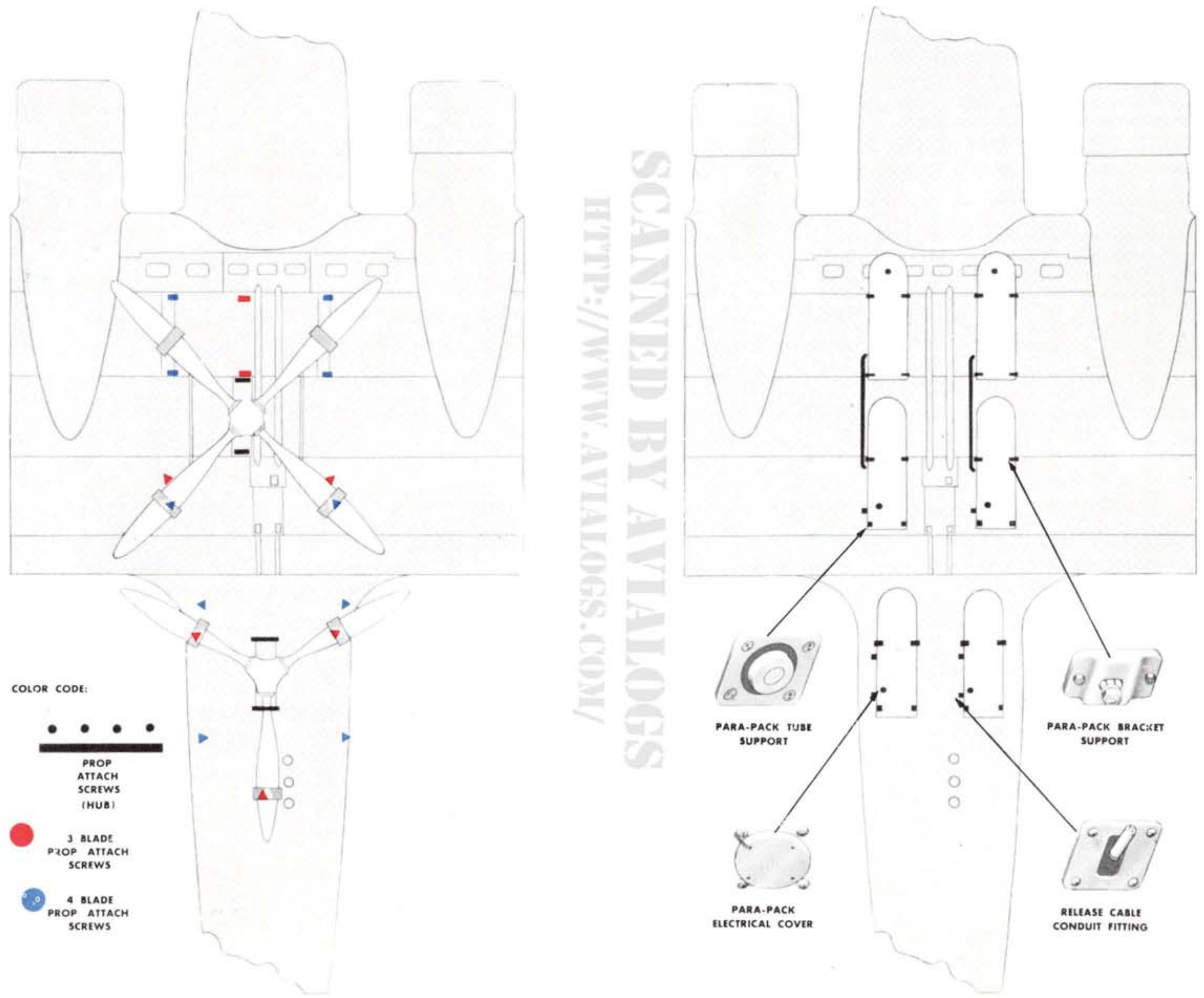

COLOR CODE:
PROP ATTACH SCREWS (HUB)
3 BLADE PROP ATTACH SCREWS
4 BLADE PROP ATTACH SCREWS
PARA-PACK TUBE SUPPORT
PARA-PACK BRACKET SUPPORT
PARA-PACK ELECTRICAL COVER
RELEASE CABLE CONDUIT FITTING

Figure 606—Attach Points and Attach Fittings for Parapack Racks and Propeller Transporting Equipment

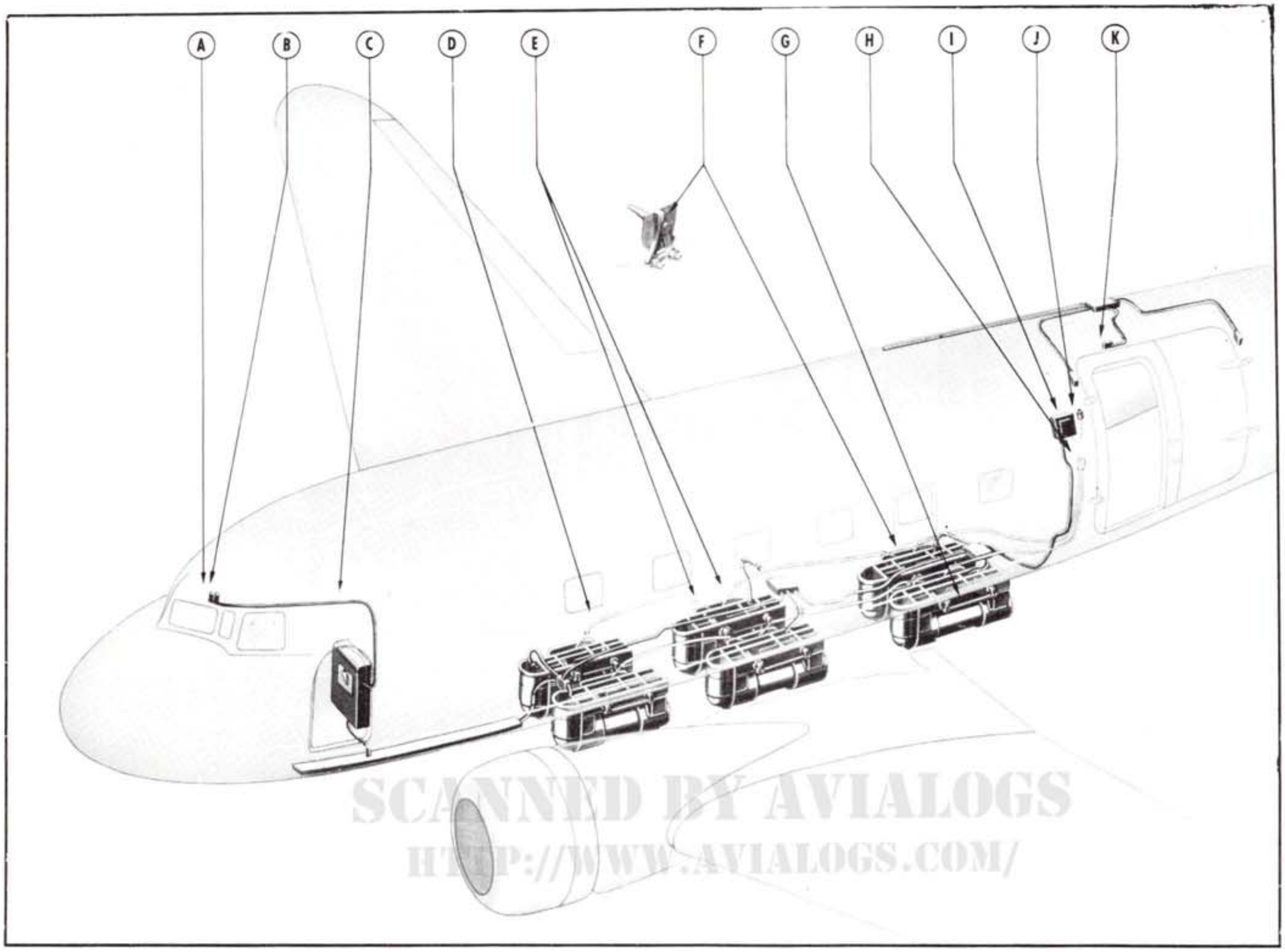


Figure 607—Parapack Release Controls

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
A	CH8200	Jumpmaster's Warning Switch (Operates "K")	1
B	CH8211-K5	Parapack Salvo Release Switch	1
C	5117260-33	Switch to Main Junction Box Conduit	1
D		Operating Wire Flexible Conduit	1
E	5139783-1, -2, and -3	Manual Release Operating Wire	6
F		Parapack Manual Release Lever	6
G		Parapack Lever Assembly	6
H	2139733	Parapack Manual Release Handbook	1
I	5139365	Jumpmaster's Control Switch Box	1
J	5139365	Jumpmaster's Hand Switch	1
K	5112265	Jumpmaster's Warning Signal Box	1

3. AFT PARACHUTE PACK RACKS. *(See figure 605.)*—The forward end of each of the two aft racks is secured by two bolts to the two fittings located in line with the forward fittings and approximately 2 feet aft of the center wing flaps. The aft end is secured by two bolts to the two built-in tube supports located directly aft of these fittings. (See figure 606.)

(b) RELEASE CONTROLS.—The release controls (figure 607) are operated and located as follows:

1. ELECTRICAL SALVO CONTROL.—This control, operated through a toggle switch on the pilot's left-hand electrical control panel, is provided for salvo release of all the packs in case of an emergency. The pilot's jump signal switch, a toggle type switch located next to the electrical salvo switch, is marked "CAUTION" and "JUMP." It operates the two lights on the jump warning box and serves as a signal from the pilot to the jumpmaster.

2. ELECTRICAL SELECTIVE CONTROL.—

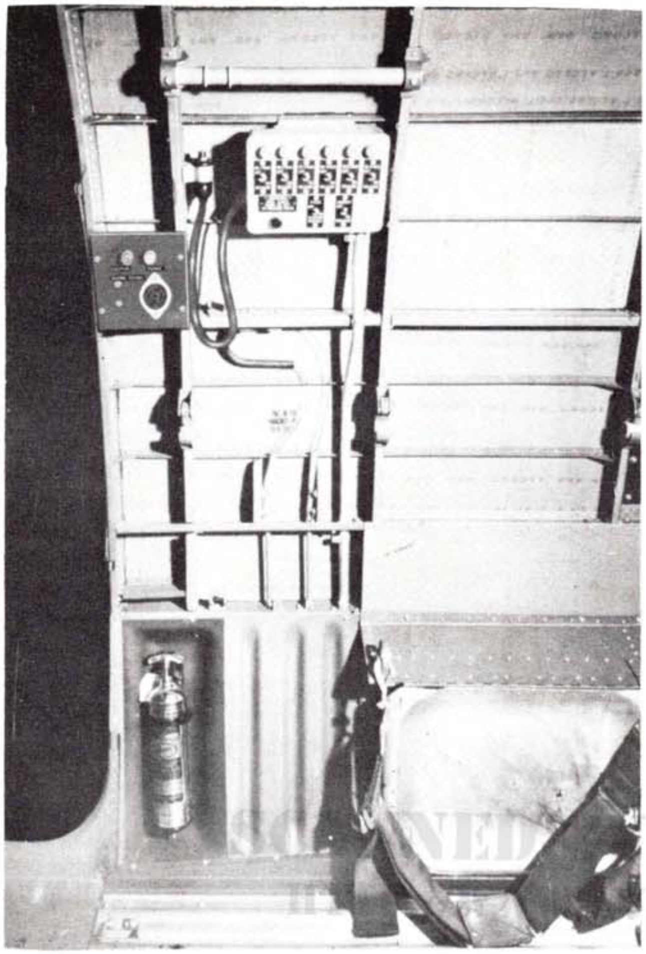


Figure 608—Jumpmaster's Release Controls

The selective control is operated through toggle switches on the parachute pack control box. These switches are operated by the jumpmaster. The control box is mounted on the left-hand side of the fuselage just forward of the cargo compartment door (figure 608). The six toggle switches on the electrical control box provide for the individual release of the packs. Each of six green parachute pack release indicator lamps, located on the electrical control box just above the selective switches, goes off, one at a time, as each pack is released. The red indicator lamp, located below the selective switches, is off when the circuit breaker switch and the master switch are "ON." Packs cannot be electrically released when the red lamp is "ON."

3. ELECTRICAL SERIES CONTROL. – This control is operated through a hand switch located on the parachute pack control box and is controlled by the jumpmaster. This switch is a push-button type (figure 608) connected to the electrical control box by a length of flexible wire. It provides a means of releasing the packs one at a time in the following order: (1) right aft, (2) left aft, (3) right center, (4) left center, (5) right forward, (6) left forward. When not in use the switch is clipped to the fuselage frame aft of the control box (figure 608).

4. JUMPERS' SIGNAL BOX.—This signal box is attached to the first frame forward of the cargo loading door, slightly below the electrical series control box. It is equipped with a red lamp marked "CAUTION" and a green lamp marked "JUMP" (figure 608). The lamps are controlled by the pilot and act as a signal to the jumpmaster to indicate when conditions are favorable for jumping. In some airplanes this jumpers' signal box was mounted directly above the cargo loading door.

5. MANUAL SALVO CONTROL.—The manual salvo control is operated by pulling a handle located on the left fuselage wall between the forward cargo door forward jamb and the first frame forward. The handle (figure 608) is U-shaped, painted red, and is provided for the salvo release of all the packs. Two wires run from the handle through conduits in the belly of the airplane and when pack racks are installed the wires extend forward and connect with the manual release mechanism on each rack. When the racks are not installed the handle is stowed in a clip attached to the fuselage frame below the release control box (figure 608).

(2) INSTALLATION PROCEDURE.

(a) PARAPACK RACK INSTALLATION.

1. Remove the manual release mechanism cover from each rack. The covers are not interchangeable.

2. Remove the 16 nuts from the bolts at the fitting attaching points on the belly of the airplane, located as shown in figure 606, and as explained in paragraph 1.*d.*(1)*(a),* this section.

3. Remove the eight dust caps from the built-in tube support attach points as shown in figure 606, and as explained in paragraph 1.*d.*(1)*(a),* this section.

4. Cut the safety wires and remove the six dust caps (figure 606) from the airplane electrical receptacles. The dust caps are round, knurled plugs, approximately 1¼ inches in diameter. There is one electrical receptacle for each rack, and the dust caps are located on the belly of the airplane as follows:

For first set of racks....	Just forward of the forward attach fittings, in line with the access hole covers marked "TANK SELECTOR VALVE COVER."
For second set of racks.	Just forward of the first set of built-in tube support fittings.
For third set of racks...	Just forward of the aft set of built-in tube support fittings.

5. Remove the caps from the ends of the manual release control wire conduits. The conduits are the small tubes that protrude down through the skin of the airplane. The two forward tubes, turned down on each end, run parallel fore and aft on the center wing approximately 18 inches to the left and right of the center line of the airplane. (See figure 606.) The small caps on the conduits may be removed by prying.

6. Lift the right-hand forward rack within 6 inches of the bottom of the center wing. Two men will be required to do this. Line the pack rack so that the four rack attach holes are located directly below the corresponding airplane attach points.

7. While the rack is held in this position, attach the electrical plug to the airplane electrical receptacle. Tighten the electrical plug lock nuts and secure them with safety wire.

8. Lift the rack to a position flush with the bottom of the center wing so that the rack attach holes coincide with the center wing attach points. Secure the aft end of the rack at the aft attach points with two bolts. Install the two bolts at the forward attach points.

9. Secure the five other racks in a similar manner.

10. Install the trailing antenna wire in the antenna wire guide on the right-hand forward rack. (See figure 605.)

(b) INSTALL THE PARACHUTE PACK MANUAL RELEASE CONTROL WIRES.

1. Install the two forward manual control wires (carried in the airplane as loose equipment) by threading the piano wire through the conduits so that the ends of each wire protrude an equal distance from the ends of the conduits.

2. Remove the jumpmaster's manual release control handle from the clip and push the control handle down flush with the flexible guides. (See figure 608.) This forces the manual release control wires through the conduits so that the ends protrude through the conduit ends on the belly of the airplane.

3. Connect the two forward manual control wires to the two manual release lever swivels (figure 607) on the two forward racks.

Note

Make certain that the release levers (figure 607) at each end of each control wire are against the "stops" before the wires are secured to the swivels. This also applies when attaching the center and the aft control wires.

4. Connect the aft end of the two forward manual control wires to the respective center rack manual release lever swivels.

5. Connect the forward end of the two center manual control wires to the respective center rack manual release lever swivels.

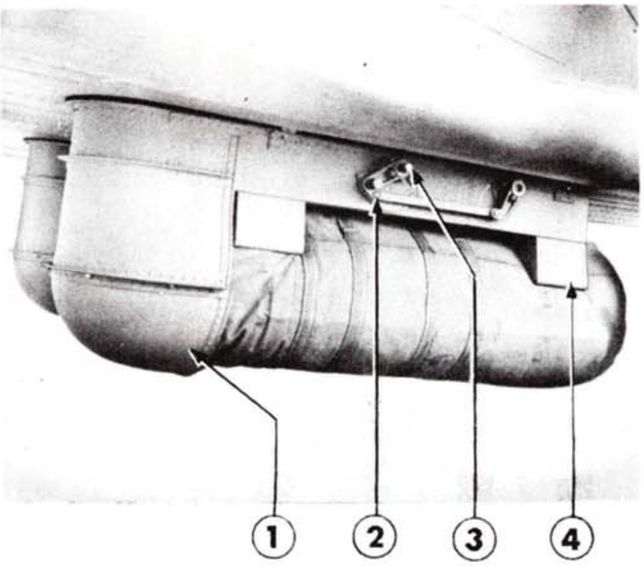


Figure 609—Loaded Parapack Rack

1. Nose Cover
2. Index Pin
3. Index Shaft End
4. Rack Chock

6. Connect the aft end of the two center manual release control wires to the respective aft rack manual release lever swivels.

7. Connect the ends of the aft control wires to the aft parachute pack release lever swivels.

8. Install each of the rack manual control mechanism covers on their respective racks.

(c) INSTALLATION OF THE PARACHUTE PACKS IN THE PARAPACK RACKS. *(See figure 609.)*

1. Remove the nose cover (1, figure 609) from each parachute pack rack.

2. Attach each of the parachute pack static cords to the fittings within the rack front shell.

3. Attach the B-7 bomb shackle in the pack lugs with the end of the shackle marked "FRONT" to the forward end of the pack. Lock the hooks by swinging the shackle release lever aft and returning it forward. Make certain the shackle is locked by pulling up and checking to see that the shackles are positively engaged in the pack lugs.

4. With the rack levers in the down position, hoist or lift the pack and attach the shackle to the rack hooks.

5. Disengage the index pin by pulling out and turning the index handle 90 degrees (2, figure 609).

6. Attach the loading crank to the index shaft end (3, figure 609) and turn it clockwise until the pack is in the normal loaded position. Engage the index pin by turning the index handle lock 90 degrees. Remove the hand crank.

7. Attach the rack nose covers and adjust the rack chocks (four to each rack) (4, figure 609).

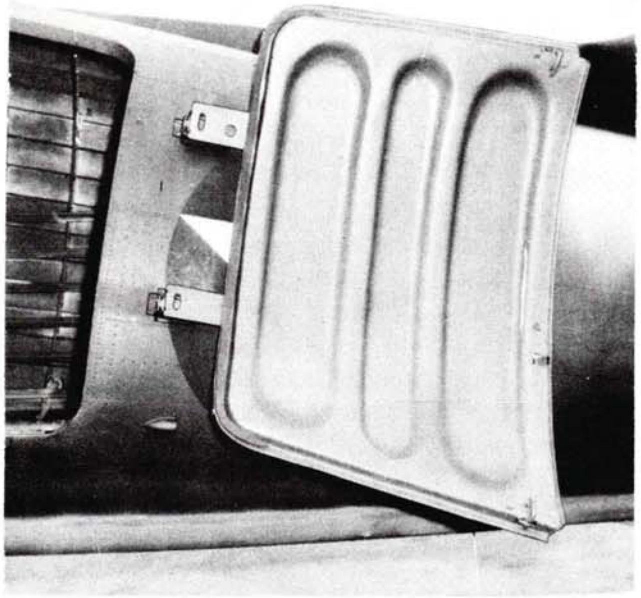


Figure 610—Aft Cargo Door Showing Redesigned Hinge

(3) MAINTENANCE REPAIR OR REPLACEMENT.

(a) As the parachute pack equipment is designed to operate without lubrication, a frequent check should be made to see that the equipment is free of dirt and oil. If an appreciable amount of foreign substance is found, clean the equipment with kerosene, Federal Specification No. VV-K-211, but DO NOT LUBRICATE.

(b) The operation of moving parts should be checked for freedom from binding.

(c) With the bomb shackle in the locked position, check for good engagement of the releasing lever with the pawl and of the pawl with the stop in the link assembly. Holes in the frame of the bomb shackle are provided for this check.

(d) Bomb shackles which are found to be faulty or which are in a doubtful condition must be replaced.

1. The type D-7 bomb shackle is to be inspected as follows at each 50-hour period. Test the arming hook spring with a standard arming wire. Holding the arming lever at "SAFE," find the force necessary to pull the wire from the retainer. The arming hook spring should resist a 3-pound pull. A 4-pound force should pull the wire from the arming wire slot. Springs failing to conform to these requirements must be replaced.

(e) Repairs to parachute pack equipment will consist of the replacement of parts when necessary, or such straightening and alignment as may be required. Whenever repairs are needed that are beyond the facilities of the service activity, the repairable parts will be appropriately marked and returned to the control depot for repair.

e. CARGO ACCOMMODATION.

(1) DESCRIPTION.—The usable fuselage width in the main cargo compartment is 79 inches. The main cargo compartment floor area is approximately 213 square feet, giving a cubic capacity of 1,227 cubic feet. Loading is accomplished through double cargo loading doors which are divided in the middle and swing out. The doors may be secured against the side of the fuselage, out of the way when loading. Cargo doors may be easily removed from their hinges when loading heavy equipment. In some airplanes of this model, the aft cargo door hinges have been so redesigned that it is not necessary to remove the door when loading. (See figure 610.) The forward cargo door is equipped with an emergency release which pulls the hinge pins should it ever be necessary to remove the door. The emergency release is a small metal handle, painted orange-yellow, located just above the lower hinge of the forward door and attached to the forward door jamb. The handle operates as a direct lever in pulling the lower hinge pin and a short cable attaches to another lever which pulls the upper hinge pin at the same time. To operate, push down on the orange-yellow handle. The doors are roughly 6 feet high at the forward edge, 7 feet wide, and 5 feet high at the aft edge. A paratroop exit door, approximately 5½ by 2½ feet, is located in the forward half of the double cargo loading door and may be opened for exit of paratroops by turning the handles located near the top of the exit door. The airplane may be loaded with cargo not exceeding specified limits. (See Handbook of Weight and Balance Data, AN 01-1B-40, in the airplane.) The following are suggested typical military loads:

(a) Four Pratt & Whitney R-1830 engines with transportation cradles.

(b) Four Curtiss V-1570 engines with cradles.

(c) Three Allison V-1710 engines with cradles.

(d) Two Wright R-3350 engines with cradles.

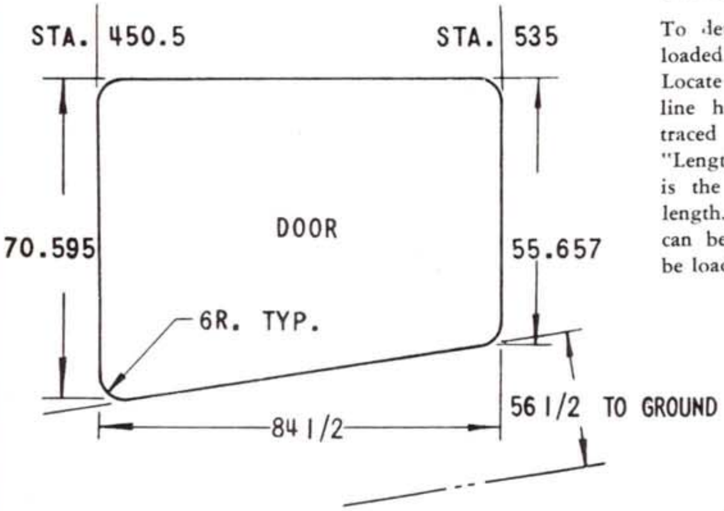
(e) Airborne task force equipment, consisting of one ¼-ton, 4 x 4 truck, (commonly known as a "jeep"), and one 37-mm antitank gun M-3 mounted on a 37-mm M-4 carriage, a 75-mm pack howitzer on a 74-mm pack howitzer carriage, or, a 75-mm field howitzer on a 75-mm gun carriage M-3A1.

Note

Package dimension limits to be used in loading this airplane are contained in the tables (figure 611) in this section. For specific information of weight and load distribution, reference should always be made to the Handbook of Weight and Balance Data, AN 01-1B-40.

(2) LOADING EQUIPMENT.

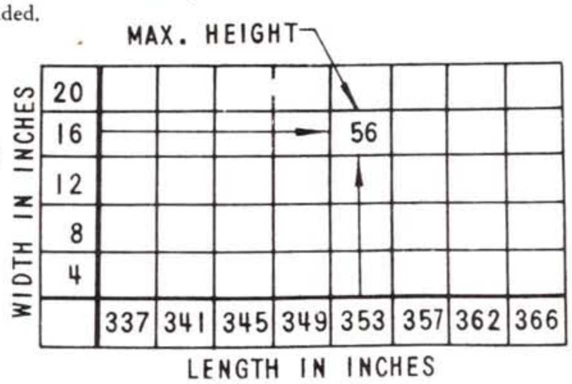
(a) SNATCH BLOCKS.—To facilitate loading,



USE OF CHART

EXAMPLE:

To determine whether or not a box 16 x 54 x 353 can be loaded through the cargo door into the cargo compartment.—Locate 16 (width) in the column marked "Width" and trace a line horizontally across the chart until it intersects a line traced vertically from 353 (length) in the column marked "Length." In the square where they intersect read "56" which is the maximum height for that combination of width and length. From the chart we see then that a box 16 x 56 x 353 can be loaded. Obviously a box 16 x 54 x 353 could easily be loaded.



WIDTH IN INCHES

56	68	60	60	60**	60**	56**	56**	56**																
52			76	72**	64**	60**	60**	60**	60**	60	56	52	52											
48			76	72**	64**	64**	64**	60**	60**	60**	56	56	56	52	52	52	48							
44			76	72**	68**	64**	64**	64**	64**	60**	56	56	56	56	56	56	52	52	52	52	48	48	44 48*	44*	
40				80	72**	64**	64**	64**	64**	64**	56	56	56	56	56	56	56	56	56	52	52	52	52	48	48
36				80	72**	68**	64**	64**	64**	64**	60	60	60	56	56	56	56	56	56	56	56	56	52	52	52
32				80	72**	68**	68**	64**	64**	64**	60	60	60	60	56	56	56	56	56	56	56	56	56	56	56
28				80	72**	72**	68**	68**	64	64	64	60	60	60	60	60	60	60	60	60	60	60	56	56	56
24				80	76	72	72	72	68	68	68	64	64	60	60	60	60	60	60	60	60	60	60	60	60
20				80	76	76	76	72	72	72	68	68	68	64	64	64	64	64	64	64	64	64	60	60	60
16				84	80	80	80	76	76	76	72	72	72	68	68	68	68	64	64	64	64	64	64	64	64
12					84	80	80	80	76	76	76	76	76	72	72	72	68	68	68	68	68	68	68	68	68
8					84	84	84	84	80	80	80	76	76	76	76	76	72	72	72	72	72	72	72	72	68
4					88	84	84	84	84	80	80	76	76	76	76	76	72	72	72	72	72	72	72	72	72
2	69	73	77	81	85	89	93	97	101	105	109	113	117	121	125	129	133	137	141	145	149	153	157	161	165

LENGTH IN INCHES

*—Indicates that the seat beam is removed between Sta. No. 372.5 and Sta. No. 450.5 RH side.

**—Indicates that the package should be turned on its side for entry.

Figure 611—Package Dimension Charts (Sheet 1 of 2 Sheets)

WIDTH IN INCHES																									
56																									
52																									
48																									
44																									
40	44 48*	40 44*	40*																						
36	52	52	52	48	48	48	44	44	36																
32	56	56	56	52	52	52	52	52	48	48	48	48	48	44	44	44	40	36	36	32	32				
28	56	56	56	56	56	56	56	56	56	56	56	56	56	52	52	52	52	52	48	48	48	48	44	44	44
24	60	60	60	60	60	60	60	60	60	60	60	60	56	56	56	56	56	56	56	56	56	56	52	52	52
20	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	56	56	56
16	64	64	64	64	64	64	64	64	64	64	64	64	60	60	60	60	60	60	60	60	60	60	60	60	60
12	68	68	68	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
8	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	64	64	64	64	64	64	64
4	72	72	72	72	72	72	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
2	169	173	177	181	185	189	193	197	201	205	209	213	217	221	225	229	233	237	241	245	249	253	257	261	265

LENGTH IN INCHES

WIDTH IN INCHES																									
56																									
52																									
48																									
44																									
40																									
36																									
32																									
28	40	40	32	28	28	28																			
24	52	52	52	52	52	48	48	48	48	48	44	40	40	40	40	36	36	32	32	32	28	28	24		
20	56	56	56	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	48	48		
16	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	56	56	56	56	56	56	56	52		
12	64	64	64	64	64	64	64	64	60	60	60	60	60	60	60	60	60	60	60	60	60	60	56	40	
8	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	60	44	
4	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	64	64	48	8
2	269	273	277	281	285	289	293	297	301	305	309	313	317	321	325	329	333	341	341	345	353	353	357	362	366

LENGTH IN INCHES

*—Indicates that the seat beam is removed between Sta. No. 372.5 and Sta. No. 450.5 RH side.

Figure 611—Package Dimension Charts (Sheet 2 of 2 Sheets)

the main cargo compartment is equipped with a snatch block, and idler pulley, and an auxiliary snatch block ring. The snatch block is installed on the right side of the cargo compartment opposite the main loading door and may be stowed against the side of the fuselage when not in use. The idler pulley is provided for deflecting the cable over and clear of the cargo door sill. Stowage for the idler pulley is provided on the aft bulkhead of the cargo compartment to the left of the lavatory door. A snatch block ring may be mounted in the floor by using the hold-down ring fitting in the center floor panel at the forward end of the main cargo compartment. This provides for the installation of an additional snatch block. When not

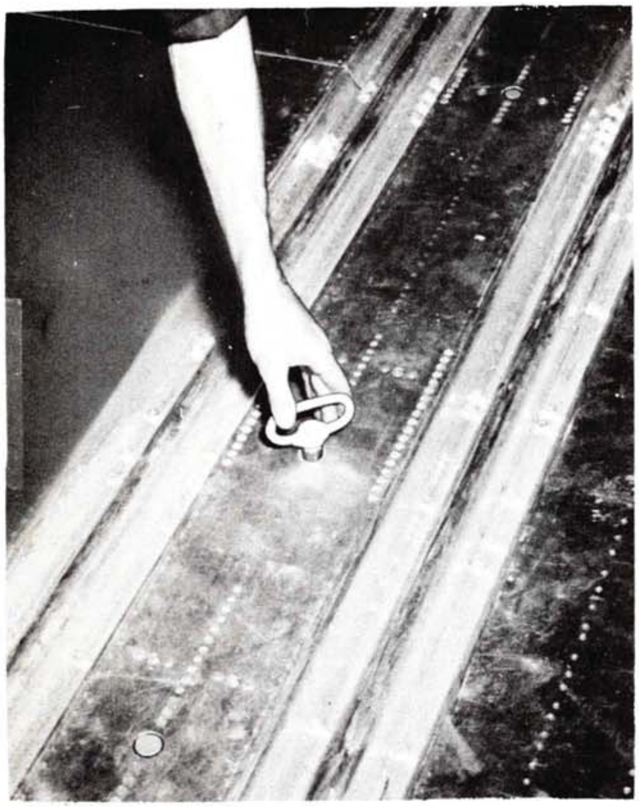


Figure 612—Installing Hold-Down Fitting in Center Floor Panel

in use, the snatch block ring is stowed just above the floor on the main cargo compartment forward bulkhead to the left of the radio compartment door. The cargo door sill structure incorporates fittings suitable for attaching loading ramps for cargo, engine cradles, or airborne task force equipment.

(b) HOLD-DOWN AND TIE-DOWN FITTINGS.—Special hold-down fittings are provided for the engine transportation cradles along the floor of the cargo compartment. Loose pieces of cargo may be fastened down by using the 16 tie-down fittings provided on the floor of the compartment or by using the safety belt attaching fittings installed along the fore and aft passenger bench support beams. Litter support tubes may also be used for tying down purposes.

1. FLOOR HOLD-DOWN FITTINGS. — Floor hold-down fittings are carried as loose equipment and are stowed in the accessory holder mounted on the bulkhead just to the left of the lavatory door. Provisions are made for the installation of floor hold-down rings in the center floor panels of the main cargo compartment. The fittings for installing the hold-down rings are located at the center line of the airplane, tapped ¾–16N.F.–3, pitch diameter .7094 + .0032 –.0000, at the following stations:

186⅝ *255⅝ *309½ *378½
210¾ 282⅝ 324⅝ 393⅝
*240½ 297¾ *351⅝ *447½

Note

Fittings at stations marked thus (*) are designed for a 1500-pound up-load, all others for a 500-pound up-load. To locate stations, as mentioned here, look for the station numbers stenciled on the frames near the top of the cargo compartment.

a. INSTALLATION.

(1) To install the floor hold-down fittings it is only necessary to remove the plugs from the center floor panel in the main cargo compartment at the points at which it has been intended to install cargo tie-down rings. These plugs may be removed by prying up with a screw driver.

(2) Screw the floor hold-down fittings into the main cargo compartment center floor panels at each location from which a plug has been removed and turn these fittings to secure a snug fit. (See figure 612.)

b. REMOVAL.

(1) When it is desired to remove the floor hold-down fittings, the rings should be unscrewed from the floor and placed in the compartment provided for them in the accessory holder.

(2) The plug buttons, previously detached from the center panels of the main cargo compartment floor, should be returned to their original locations. A slight tap with a hammer is all that is needed for the installation of the plugs.

2. TIE-DOWN RINGS.—Tie-down rings are located on the corrugated floor on each side of the fuselage and are designed for a 200-pound load in any direction and are located at the following stations:

177½ 258½ 294½ 411½
216½ 372½ 333½ 450½

Note

To locate stations as mentioned here, look for station numbers stenciled on the frames near the top of the cargo compartment.

3. SAFETY BELT RINGS. — Rings on the seat support beam are designed for a 500-pound load within 45 degrees on either side of the plane of the rings. These rings are located approximately 19 inches on centers between station 177½ (radio compartment bulkhead) and station 450½ (just forward of the cargo loading door) on both sides of the fuselage, 17 inches from the floor.

4. LITTER SUPPORT TUBES.—The litter support tubes located on each side of the fuselage, between the frames, 57 inches from the floor, are designed for a 75-pound load in any direction.

5. TIE-DOWN EQUIPMENT. — Cargo tie-down equipment for these airplanes is provided in a kit designated as AAF set R-2. This kit consists of the following items: 30 hooks, 15 tighteners, 20 rods, 10 beams, 20 locks, two jacks, 15 lengths of rope, six jeep and gun tie-down hooks, six jeep and gun hook short rods, abrasive cloth, container, and rope hanger.

(c) LOADING RAMPS. – The loading ramp, consisting of two tracks and a small and large platform, is provided to assist in performing the special equipment loading operations. Each track attaches to the cargo door sill by means of a single metal dowel protruding from a metal angle that overlaps the cargo door sill. The single dowel attachment provides for any slight angular deviations that may be necessary during the loading operations. The words "75-mm FIELD HOWITZ, ENGINES, JEEP, 37-mm GUN AND MOTORCYCLE" are plainly stenciled on the skin of the airplane below the cargo door sill to indicate the proper loading ramp attach points for loading the various types of equipment. The tracks are attached to the fuselage at an angle of approximately 55 degrees to the center line of the airplane. The two platforms are provided to be used with the ramps in order to create a larger, comparatively level, loading area. (See figure 613.)

1. SMALL PLATFORM.–The smaller platform is constructed in the shape of a triangle with two fittings protruding, one from the forward end, and one from the right-hand side, to overlap the cargo door sill and the forward loading track respectively. The side fitting incorporates a metal dowel in the approximate center of the fitting that secures the platform to the track. The use of this platform will be mentioned in the following paragraphs regarding the loading operations.

2. LARGE PLATFORM. – The larger platform, which is made to fit between the two tracks, is constructed so as to incorporate an auxiliary platform at the right-hand end, hinged to the platform proper and swung underneath into the stowed position when not in use. The auxiliary platform is held in this stowed position by means of a pin fitting. When necessary, this auxiliary platform may be swung upward to form a larger platform and fill the space created by moving the two tracks to their extreme positions. (See figure 613.) The use of this platform is mentioned in the following paragraphs regarding the loading operation.

f. SPECIAL LOADING INSTRUCTIONS.

(1) DESCRIPTION.–The procedures for loading engine transportation cradles and general loose cargo into the model C-47 and C-47A (Navy R4D-1 and R4D-5) transport airplanes are familiar to ground personnel and may be accomplished by the use of engine transportation loading ramps or general cargo loading ramps.

(2) LOADING AIRBORNE TASK FORCE EQUIPMENT.

Note

In some airplanes, the aft portion of the main cargo door must be removed from its hinges before loading. The quarter-ton truck shall be loaded in the forward end of the compartment and the gun, muzzle forward, shall be loaded as close to the truck as possible.

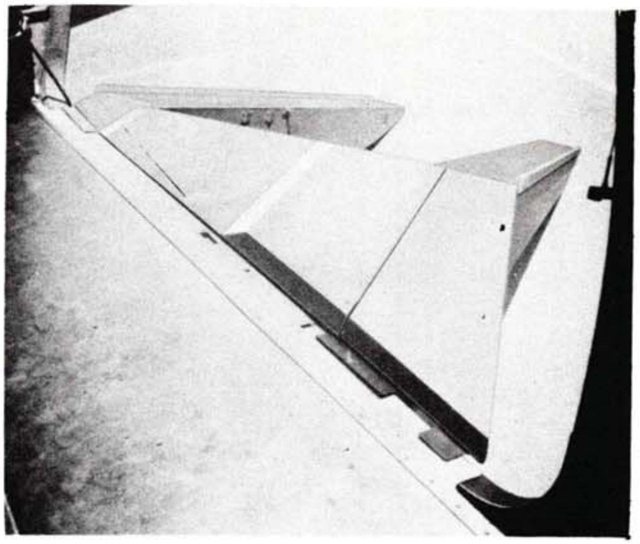


Figure 613—Loading Ramp and Platform in Position for Loading Field Howitzer

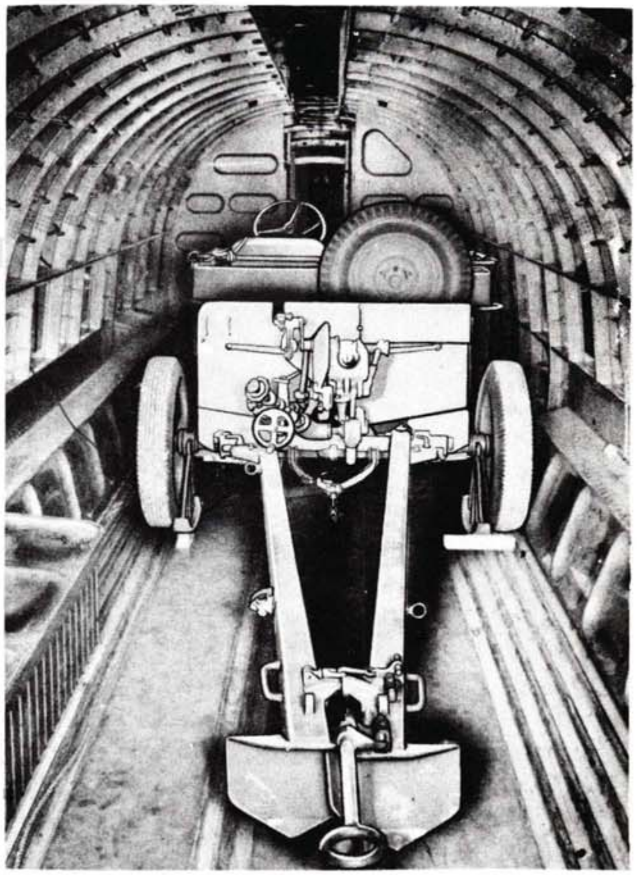


Figure 614—Jeep and Small Gun in Loaded Position

(a) LOADING A "JEEP."–To load the quarter-ton truck or "jeep," either of the following procedures may be used:

1. USING THE TRUCK'S OWN POWER.

a. Place one track into the next to the last aft fitting in the cargo door sill structure, and the other track into the forward fitting that will place the ramp in the position to accommodate the tread of the truck. The ramp will assume an angle of approximately 55 degrees to the center line of the fuselage. These fittings are marked "JEEP."

b. Place the small triangular platform into the fitting on the forward track. This will form a platform forward of the loading ramps.

c. Place the larger platform with the auxiliary portion in the stowed position, between the two tracks. The platform rests on the two tracks by means of two fittings protruding from the platform.

d. The truck may now be run up the ramp under its own power. As it reaches the top of the ramp the wheels should be turned to the left. The operator of the truck should watch closely the clearance between the truck and the forward part of the door structure.

e. When the clearance becomes too small to manipulate the truck further under its own power, the brakes should be set, and three or four men should bounce the aft end of the truck into the airplane.

f. From there the truck may continue under its own power forward to the front of the cargo compartment. (See figure 614.) Care must be exercised not to apply too much power to the wheels because the wheels may slip or skid on the flooring of the airplane.

2. USING A BLOCK AND TACKLE.

a. Place the tracks and the platforms in their proper places as noted in the preceding paragraphs 1.*f*.(2)*(a)1*.a..b., and c.

b. Remove the auxiliary snatch block ring from its place of stowage on the forward bulkhead of the cargo compartment and install it in the hold-down fitting in the center floor panel at the forward end of the cargo compartment. Attach a block and tackle.

c. Remove the idler pulley from its place of stowage on the aft bulkhead of the cargo compartment and place it in the approximate center of the cargo door sill.

d. Attach a cable to the block and tackle, route it around the snatch block at the forward end of the loading platform, over the idler pulley and attach it to the truck.

e. Pull the truck up the incline of the ramp from within the cargo compartment until it reaches the level loading platform.

f. Set the brakes, detach the cable from the truck and bounce the aft end of the truck into the airplane.

g. The block and tackle may now be attached directly to the truck and the truck can now be pulled forward to its proper position in the cargo compartment.

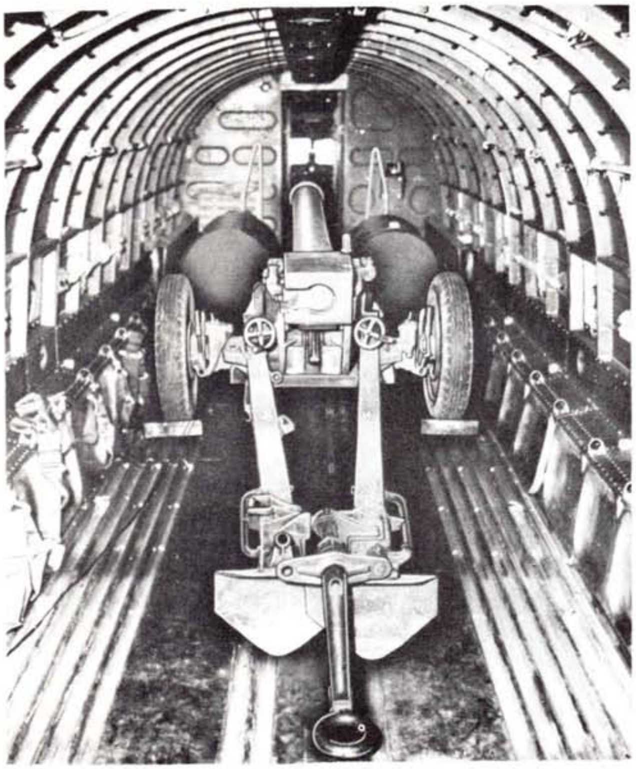


Figure 615—Field Howitzer in Loaded Position

(b) TO LOAD THE 75-mm HOWITZER FIELD GUN. *(See figure 615.)*

1. Place the aft track in the last rearward fitting in the cargo door sill, and the forward track in the first fitting of the door sill. These fittings are marked "75-mm HOWITZ." The small triangular platform is not used in this case. The large platform is placed between the two tracks and the auxiliary portion is swung upward into its place to fill the space created by moving the two tracks apart. (See figure 613.)

2. Install the snatch block ring in the fitting on the floor at the forward end of the cargo compartment. Attach a block and tackle.

Note

If the truck or other equipment has already been placed in the forward portion of the cargo compartment, the block and tackle may still be used from the forward fitting, as it will have ample space under the truck in which to operate, or, the snatch block ring can be attached to the floor hold-down fitting in the center floor panel just aft of the equipment and the block and tackle installed.

3. Attach a cable to the block and tackle, route it around the snatch block at the forward end of the loading platform, over the idler pulley at the approximate center of the cargo door sill, and attach the cable to the howitzer.

4. Using the block and tackle and cable from within the cargo compartment, pull the howitzer up the incline until the hub of the left wheel is opposite the forward portion of the cargo door sill. Lock the left wheel.

Note

> After the howitzer wheels have started up the ramp, a rail must be placed across the two tracks on which the "plow" of the howitzer will ride up the incline.

5. Holding the howitzer in its place on the platform, detach the cable and attach the block and tackle directly to the howitzer.

6. With the left wheel locked, pull the howitzer forward, at the same time raising the plow so it will pass into the fuselage through the upper aft corner of the cargo door. As the left wheel is locked, the right wheel swings around toward the front of the airplane.

7. When the plow is in the required position the left wheel may be unlocked and the howitzer pulled forward into the cargo compartment. The plow must be carried along until it clears the cargo door sill. As it passes through the entrance, the plow should be moved toward the center of the main cargo compartment and set on the floor. (See figure 615.)

8. Pull the howitzer to its designated position and secure it in place.

(c) TO LOAD THE 75-mm HOWITZER PACK GUN.—To load the 75-mm howitzer pack gun, the procedure outlined for the field gun should be followed. The pack gun will be much easier to maneuver into place because of its smaller size and lighter weight.

(d) TO LOAD THE 37-mm ANTITANK GUN.—The procedure for loading the 37-mm antitank gun is similar to the procedure outlined for the 75-mm howitzer in the preceding paragraphs.

(3) UNLOADING OPERATIONS.—The unloading operations for the special equipment are the reverse of the loading procedures outlined in the preceding paragraphs.

g. GLIDER TOW PROVISIONS.

(1) DESCRIPTION.—On some airplanes, a glider tow attachment is installed in the tail cone. The tow consists of a release unit attached by four tube assemblies to heavy support channels which are bolted to the fuselage structure (see figure 616.) Two heavy jaws inside the release unit engage a ring in the glider tow attachment. The jaws are opened by pulling a tee-shaped metal handle marked "GLIDER RELEASE" located on the bulkhead directly in back of the copilot's seat. The handle is attached to a cable that passes through a conduit along the top of the cargo compartment through the entire length of the airplane. The cable attaches to a release lever on the release unit. Tension on the cable pulls the release lever which in turn opens the jaws inside the release unit. This disengages the glider attach fitting which pulls loose from the release unit. On C-47A and early C-47B airplanes only, an indicator, consisting of a metal pin moving through a hex nut is located on the bottom of the release unit approximately 4 inches from the end. This indicator serves to signify the position of the locking device. When the clamping jaws are in the closed position, the pin protrudes from the top of the hex nut. If the jaws are not completely closed the pin will not be visible, thereby warning of insecure attachment.

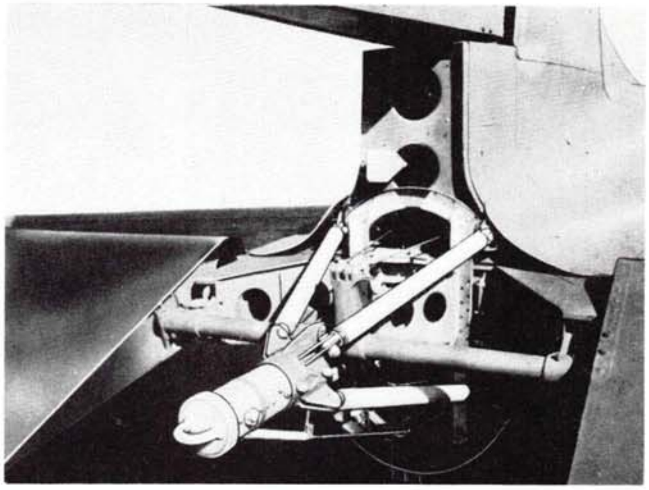


Figure 616—Glider Tow Mechanism

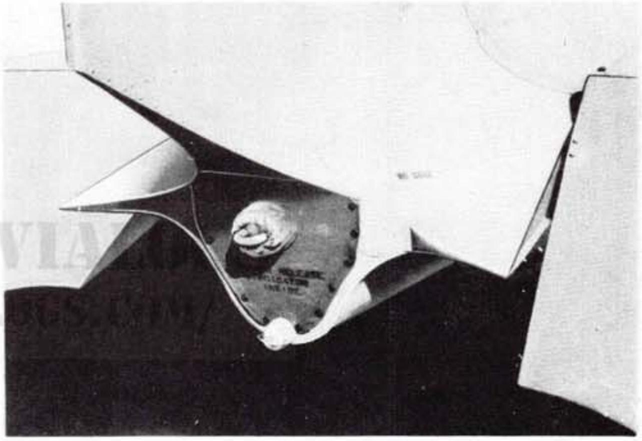


Figure 617—Glider Tow Cover

Note

> On some airplanes of this model, this safety indicator is located directly on top of the release unit, approximately 4 inches from the end of the release unit.

Three interphone jacks are mounted on a triangular shaped Micarta panel which is attached to the tail cone structure just below the glider tow release unit. The glider tow unit is covered by a canvas cover which snaps onto the tail cone and slips over the end of the glider release unit. (See figure 617.)

(2) REMOVAL AND DISASSEMBLY.

(a) Remove the canvas cover that fits over the end of the tail cone.

(b) Disconnect all electrical wiring running aft from where the tail cone attaches to the fuselage.

(c) Remove tail cone by removing the screws that attach the rear end of the stabilizer fairing to the tail cone.

(d) Remove the screws attaching the tail cone to the fuselage.

(e) Remove the tail cone by pulling it aft.

(f) Remove the pin, the washer, and the cotter that attach the release cable to the arm assembly on the glider tow release unit.

(g) Remove the four bolts that attach the tube assembly to the fittings bolted on to the fuselage structure. This will permit the glider tow unit to drop free from the airplane.

(h) Disconnect the release handle by removing the two bolts that hold the bracket to the pilot's compartment aft bulkhead.

(i) Disconnect the turnbuckle on the cable just aft of the rear lavatory bulkhead.

(j) Pull the rear cable through the opening at the aft end of the airplane.

(k) Remove the forward cable by pulling it into the pilot's compartment.

(3) MAINTENANCE AND REPAIR OR REPLACEMENT.

(a) Make a test operation of the release mechanism before each towing operation. Any damaged or badly worn parts must be replaced.

(b) MAJOR OVERHAUL.

1. Completely disassemble all parts of the mechanism.

2. Check all parts for wear or damage.

3. Replace any parts necessary.

4. Reassemble by reversing the disassembly procedure.

5. Check cable for wear and for proper tension. (See cable rigging chart figure 336.)

6. Test the operation of the entire mechanism.

b. LOADING WITHIN WEIGHT AND BALANCE LIMITS.

(1) GENERAL. — Haphazard loading, without proper consideration for weight and balance limits, is as obsolete and dangerous as making haphazard mechanical repairs. This airplane has definite restrictions on the amount of weight which can be concentrated within a particular area of floor space, as well as on the total weight which can be carried by the entire airplane. Likewise, there are definite balance requirements which must be complied with or the airplane will sacrifice speed, range, and ceiling; or it may even become critically dangerous to fly, depending upon how seriously it is loaded out of balance.

(2) COMPARTMENTS.—The airplane is zoned into eight compartments, lettered consecutively from "A" to "H" inclusive, (see figure 618), mainly for the purpose of keeping an accurate check on weight distribution and for computing the balance of a given load arrangement.

(a) COMPARTMENT LOAD LIMITS.—Each compartment has a structural load capacity which must not be exceeded. The maximum allowable load for each compartment follows:

A	(Pilots' compartment)	600 lbs
B	(Baggage compartment)	800 lbs
C	(Radio man and navigator's compartment)	1000 lbs
D	(Cargo compartment)	3000 lbs
E	(Cargo compartment)	3000 lbs
F	(Cargo compartment)	2400 lbs
G	(Cargo compartment)	1300 lbs
H	(Lavatory compartment)	350 lbs*

*(350 lbs plus the weight of one man.)

Note

The structural weight capacities of compartments in this airplane occasionally are altered. For up-to-date information regarding the structural capacities of compartments, refer to chart "E" contained in Handbook of Weight and Balance Data (AN 01-1B-40), which is carried in the airplane.

(b) FLOOR LOAD LIMITS.—Consult chart "E" contained in Handbook of Weight and Balance Data (AN 01-1B-40), for the maximum weight with which a limited area of a given compartment may be safely loaded.

(c) GROSS WEIGHT LIMITS. — The recommended maximum gross weight (the weight of the airplane and all of its contents) for take-off and landing is 33,000 pounds.

(3) CENTER OF GRAVITY LOCATION.—The location of the center of gravity (balance point between nose and tail) is largely dependent upon the load distribution in the airplane. If the load is shifted forward, the center of gravity will shift forward also. Conversely, if the load is shifted aft, the center of gravity will shift aft. Since the wings support the airplane in flight, playing somewhat the same role as the fulcrum under a teeter board. it naturally follows that if the center of gravity is located too far forward, the airplane will be nose-heavy; and if the center of gravity is located too far aft, the airplane will be tail-heavy. An important phase of the loading procedure is to distribute the items of weight so that the center

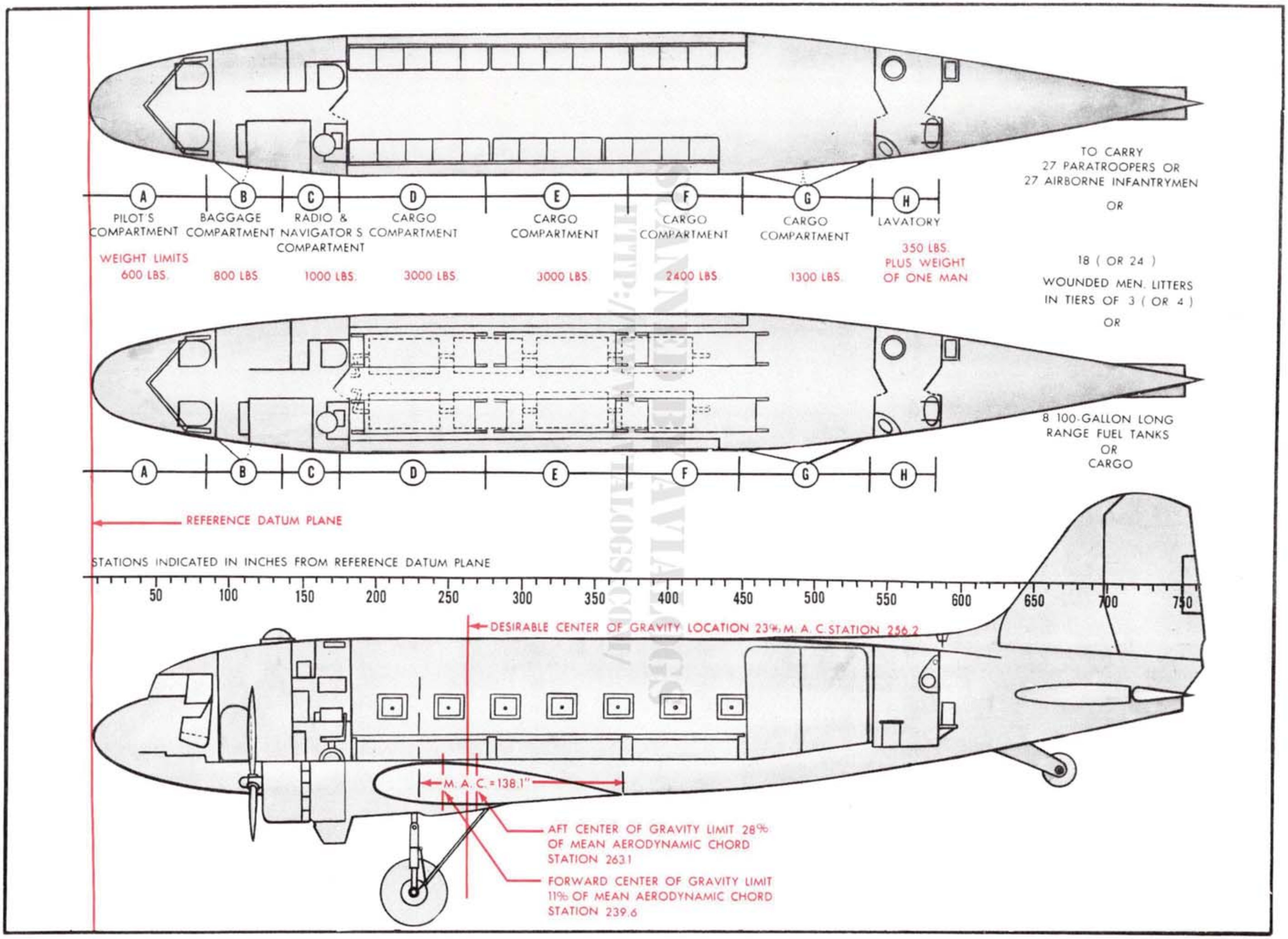

A
B
C
D
E
F
G
H
PILOT'S COMPARTMENT
BAGGAGE COMPARTMENT
RADIO & NAVIGATOR S COMPARTMENT
CARGO COMPARTMENT
CARGO COMPARTMENT
CARGO COMPARTMENT
CARGO COMPARTMENT
LAVATORY
WEIGHT LIMITS
600 LBS.
800 LBS.
1000 LBS.
3000 LBS.
3000 LBS.
2400 LBS.
1300 LBS.
350 LBS. PLUS WEIGHT OF ONE MAN
TO CARRY 27 PARATROOPERS OR 27 AIRBORNE INFANTRYMEN
OR
18 (OR 24) WOUNDED MEN. LITTERS IN TIERS OF 3 (OR 4)
OR
8 100-GALLON LONG RANGE FUEL TANKS OR CARGO
REFERENCE DATUM PLANE
STATIONS INDICATED IN INCHES FROM REFERENCE DATUM PLANE
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
DESIRABLE CENTER OF GRAVITY LOCATION 23% M. A. C. STATION 256.2
M. A. C. = 138.1"
AFT CENTER OF GRAVITY LIMIT 28% OF MEAN AERODYNAMIC CHORD STATION 263.1
FORWARD CENTER OF GRAVITY LIMIT 11% OF MEAN AERODYNAMIC CHORD STATION 239.6

Figure 618—Compartments Loading Diagram

of gravity will be in its most desirable location with reference to the lift forces of the airplane. Good loading cannot be accomplished without keeping an accurate check, not only on *how much* weight is loaded into the airplane, but also an accurate check on where the various items of weight are located.

(4) DESIRABLE CENTER OF GRAVITY LOCATION.—The most desirable center of gravity location for this airplane is station 256.2. This means that the lift forces support the airplane in most satisfactory balance when the center of gravity is located 256.2 inches *aft of the nose.*

Note

> The nose of this airplane marks the location of the imaginary, vertical reference datum plane, as indicated in figure 618. The purpose of the reference datum is to provide a definite reference position from which distances parallel with the longitudinal axis of the airplane can be measured. Station numbers are always indicated in inches. Hence, any given station number means that its location is as many inches aft of the reference datum plane as the number of the station.

(5) PERMISSIBLE CENTER OF GRAVITY RANGE.—While the aim of loading in this airplane is to locate the center of gravity at station 256.2, it is seldom practicable to distribute the load in such perfect balance as to hit this position exactly. Such perfect balance, moreover, is not required for safe operation. The airplane will fly safely if its center of gravity is located anywhere within its permissible center of gravity range. This range extends from station 239.6 to station 263.1. Since center of gravity locations are usually expressed in terms of percent m.a.c. (mean aerodynamic chord), instead of inches, the forward limit (station 239.6) is called 11 percent m.a.c., the aft limit (station 263.1), 28 percent m.a.c.; while the desirable location (station 256.2) is called 23 percent m.a.c. (See figure 618.) Therefore, in loading this airplane, the aim should be to locate the center of gravity as nearly as practicable to 23 percent m.a.c.; and in all cases, to locate the center of gravity between 11 percent m.a.c. and 28 percent m.a.c. It should be remembered, however, that perfect balance is required for the most efficient operation of the airplane. Even though the center of gravity lies within its permissible range, but is not at its most desirable location, the degree of unbalance present must be corrected in flight by the pilot with the elevator trim tabs. Since trimming adds drag, the airplane will sacrifice speed, range, and ceiling, as well as forfeit certain safety factors, where elevator trimming becomes necessary. Therefore, it is highly preferable that the airplane be so well-balanced that the elevator trim tabs may be set at zero. It should also be remembered that the use of elevator trimming tabs are helpful in correcting an unbalanced condition only when the center of gravity lies within its permissible range. If the center of gravity lies outside of this range, the airplane will assume dangerous flight characteristics and may encounter serious trouble.

WARNING

> This airplane must not take off when its center of gravity location is less than 11 percent m.a.c. or more than 28 percent m.a.c.

(6) CHECKING AIRPLANE BALANCE. — Two devices are employed in checking the balance (ie, the center of gravity location) of any given load arrangement that is planned. These devices are a mechanical computer (load adjuster) utilizing the principle of a mathematics slide rule, and a series of tables and graphs contained in chart "E" in the Handbook of Weight and Balance Data (AN 01-1B-40), which is carried in the airplane. For complete details on the use of these two devices, as well as further information on loading and balancing, consult this reference.

2. NAVIGATION PROVISIONS.

a. NAVIGATOR'S COMPARTMENT.—A navigator's compartment is provided on the left side of the crew passageway aft of the pilot's compartment and across the aisle from the radio operator's table and chair. The compartment is equipped with a navigator's table and stool. The table is mounted at the forward bulkhead of the compartment and is hinged on the inboard side so that it may be lifted up to form a larger working area. When the table is extended, the hinged half lifts up and extends across the aisle. It is held in place by two simple bolt-type fasteners which may be slid into socket fittings on the plate forward of the radio equipment and on the end of the radio operator's table. The stool is fastened to the floor aft of the table and provides a seat for the navigator when he is working at the table. There is a type A-11 work light mounted on the forward outboard edge of the table. This lamp is adjustable and is controlled by a toggle-type switch marked "WORK LIGHT." The switch is mounted on a wooden support plate directly over the table. A dome light and switch is also provided on this overhead support plate. The work light may be moved out of the way and clipped against the side of the fuselage when not in use. (See figure 619.)

b. NAVIGATOR'S EQUIPMENT. — A type D-12 Pioneer compass is installed on a wooden shelf attached to the outboard aft end of the navigator's table to the left of the navigator's stool. A type B-5 driftmeter is mounted on this same shelf aft of and adjacent to the compass. On some airplanes a remote indicating compass is being installed in place of the type D-12 compass. There is a screw top tube mounted under the navigator's table, for use as a navigating chart case. The tube is secured by a web snap-on strap and the tube may be removed from its stowage place by unsnapping the web strap. An astrodome is located at the top of the fuselage on the center line of the air-

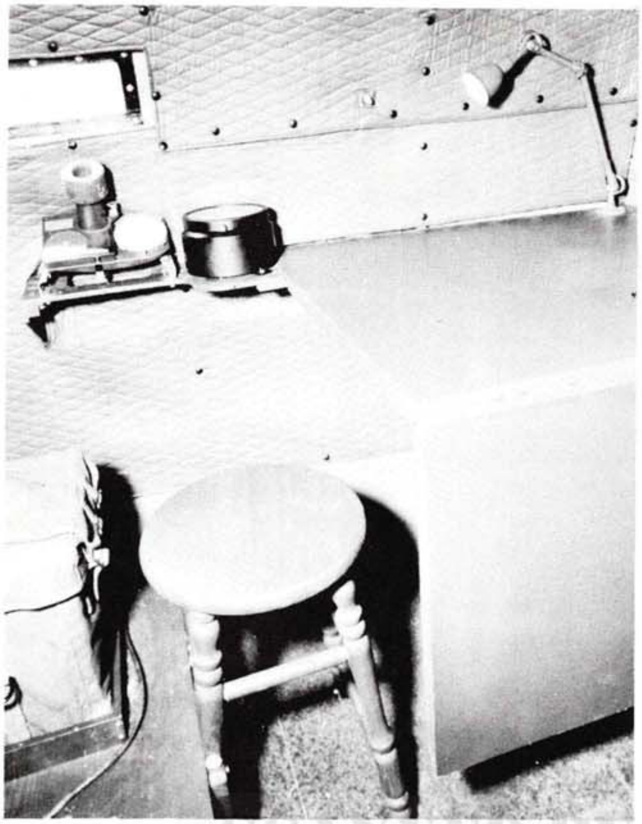


Figure 619—Navigator's Equipment

plane just forward of the navigator's compartment. A wooden mounting support for mounting an astrocompass is located directly under the astrodome. To prevent the building up, during flight, of a potential difference between astrodome disc and aircraft structure with consequent static and radio interference from electrical discharges, and to prevent possible fire hazard, astrodome discs are grounded to the aircraft structure with astrodome grounding strap. The astrocompass mount support fits over and slides on two rods which allows the support to be moved freely forwards or aft.

3. PYROTECHNICS.

a. GENERAL.—The airplane contains the following pyrotechnic provisions: a pyrotechnic pistol mount, a pyrotechnic pistol, a pyrotechnic pistol holder, a signal flare ("ammunition") container, and ammunition. The function of pyrotechnics is to transmit various colored signals from the airplane, and to project flares for reconnaissance purposes. The pistol mount is located in the upper left fuselage wall of the baggage compartment (compartment "B"), while all other pyrotechnic equipment is located near the inboard end of the compass receiver box, behind the navigator's seat, in compartment "C" (figure 618).

b. PYROTECHNIC PISTOL MOUNT.

(1) DESCRIPTION. — Pyrotechnic pistol mount M-1 is installed in the fuselage on the upper left side of the baggage compartment, $2\frac{1}{2}$ feet above the baggage compartment door. The M-1 mount is of the spring recoil type and is fastened to the aircraft by machine bolts. Its function is to hold the pyrotechnic pistol in position while the pistol is being fired. When the pistol is removed from the mount, following firing, the vent through the center of the mount is covered with a metal cap which is attached to the mount by a chain. The cover cap is placed in position by merely inserting it into the vent.

c. PYROTECHNIC PISTOL.

(1) DESCRIPTION. — Pyrotechnic pistol M-8 is carried in the airplane as a loose item until the airplane is assigned to active service. Thereafter it is carried in a pistol holder located on top of the compass receiver box aft and inboard of the navigator's seat. Pyrotechnic pistol M-8 is a snub-nosed, single-shot, breech-lock type pistol with a 1.56-inch bore of seamless steel. It will discharge a variety of flares and signals (see paragraph 3.*e.* following), and either type of ammunition may be hand fired or fired from the mount position.

(2) OPERATION.

(a) ATTACHING PISTOL TO MOUNT. — Hold the pistol by the grip with the right hand. Position the recoil lugs of the barrel with the slots in the recoil sleeves of the mount. Push the pistol fully forward and rotate it one-eighth turn, either right or left. This latter movement will snap the pistol into position.

(b) LOADING.—To open the M-8 breech for loading, push the breech lever forward with the right thumb. The action of the trigger and the firing pin should be tested before ammunition is inserted. When loading the cartridge type of signal, insertion must be made through the breech end of the barrel. However, rimless type signals can be loaded either through the muzzle or breech end, although this type should be loaded through the muzzle only when the pistol is to be hand fired.

CAUTION

> Before loading, always glance into the barrel chamber to detect obstructions.
>
> Be sure the pistol is in the proper position, and its breech locked, before firing is attempted.
>
> Since the pistol is cocked at all times when the breech is closed, a live signal must never be left in the pistol when it is removed from the mount. Place a cartridge in the chamber only when immediate use is anticipated.

(c) FIRING.—The pistol is fired by a continuous squeeze on the trigger. Whenever the pistol is hand fired (fired when not anchored in its mount), precaution should be taken to point the pistol to the rear flank in such a manner that the pyrotechnic will not strike the aircraft. If the signal fails to fire on first trial, repeat the trigger action twice, if necessary. If the signal still fails to fire, count 30 slowly before unloading. Then unload and inspect the firing pin. If it functions properly, reload with a new signal.

(d) REMOVING PISTOL FROM MOUNT.— To remove the pistol from its mount, pull the mount

release lever (located directly forward of the breech lock lever), and turn the pistol either right or left one-eighth turn. This action releases the pistol from the mount.

(e) MAINTENANCE. – The M-8 pyrotechnic pistol should be thoroughly cleaned and oiled after it has been fired. It also should be inspected, cleaned, and oiled at intervals, in normal climates and under normal conditions. However, daily care is required in dusty, wet, or salt air climates. Light preservative lubricating oil is best for all climates.

CAUTION

The barrel bore must be thoroughly cleaned to remove oil before firing is attempted.

In temperatures below –18°C (0°F), the entire pistol should be disassembled and wiped free of oil before firing is attempted.

d. PYROTECHNIC PISTOL HOLDER.–Pyrotechnic pistol M-8 is contained in an elongated canvas holder, type A-2. Like the pistol, it is carried as a loose item until the airplane is assigned to active service. Thereafter, containing the pistol, it is located on top of the compass receiver box behind the navigator's seat. The pistol and holder are lashed to the signal flare container by two long straps attached to the container. Then both units are anchored in the airplane by two web straps which are attached to the top of the compass receiver box near its inboard end. All web straps of the assembly should be replaced if they become damaged or worn.

e. SIGNAL FLARE CONTAINER.–The canvas signal flare container, type A-8, is carried as a loose item in the airplane until the airplane is assigned to active service. It is then filled with appropriate signal and flare ammunition and located on top of the compass receiver box with the pyrotechnic pistol. The container is divided by canvas partitions into 14 small compartments into which 14 units of rimless or shotgun type signals and six flares may be inserted and held in place.

f. SIGNAL FLARE AMMUNITION FOR PYROTECHNIC PISTOL M-8.

(1) TYPES.–There are two specific models of aircraft flares and two general types of aircraft signals that are used in aircraft pyrotechnic pistols. A large variety of both general types of signals can be used in pyrotechnic pistol M-8, but only one model of flare can be used.

(2) FLARES.–Pyrotechnic pistol M-8 carried in this airplane can use only one type of aircraft flare–aircraft parachute flare M-9A1. Upon ignition, this flare burns for 1 minute with a light of 60,000 candlepower, while dropping at an average of 7 feet per second. The complete round is 13.8 inches in length, approximately 2 inches in diameter for the greater part of the length, and 1.56 inches in diameter at the base where it fits into the pistol. The round weighs 1.9 pounds. These flares are packed one per metal container, 25 per box.

CAUTION

Never fire this flare from a grounded ship.

(3) SIGNALS.–Two distinctive types of signals can be fired from pyrotechnic pistol M-8–those assembled in aluminum cases, and those assembled in paper and brass cases. The aluminum type is commonly referred to as the rimless type, while the paper and brass case type is commonly called the cartridge type. A number of varieties is included in each of these types; such as those with or without parachutes, those with single or double stars, and those with single or double colors.

(a) RIMLESS (ALUMINUM) TYPE SIGNALS. –These signals may be identified by the markings on the case and on the identification top. They are 1.56 inches in diameter and 3 to 3.82 inches in length.

RIMLESS TYPE AIRCRAFT SIGNALS WHICH CAN BE USED IN PYROTECHNIC PISTOL M-8

Model	*Identification Letter(s)*	*Color(s)*	*No. of Stars*	*Burning Period (Seconds)*	*Candlepower*	*Parachute*	*Falling Rate (Ft/Sec)*
M-11	RP	Red	1	30	20,000	Yes	6
AN-M34	R	Red	1	7	9,000	No	Free-falling
AN-M35	Y	Yellow	1	7	2,000	No	Free-falling
AN-M36	G	Green	1	7	6,000	No	Free-falling
AN-M28	RR	Red-Red	2	7	9,000	No	Free-falling
AN-M29	YY	Yellow-Yellow	2	7	2,000	No	Free-falling
AN-M30	GG	Green-Green	2	7	6,000	No	Free-falling
AN-M31	RY	Red-Yellow	2	7	9,000 Red 2,000 Yellow	No	Free-falling
AN-M32	RG	Red-Green	2	7	9,000 Red 6,000 Green	No	Free-falling
AN-M33	GY	Green-Yellow	2	7	6,000 Green 20,000 Yellow	No	Free-falling

(b) CARTRIDGE (PAPER AND BRASS) TYPE SIGNALS.—These signals are assembled in a shotgun type shell of cartridge paper with a brass head. The signal cartridge is 3.85 inches in length by 1.537 inches in diameter. The paper ends of these signals are marked to correspond with the color(s) of the signals.

CARTRIDGE TYPE AIRCRAFT SIGNALS WHICH CAN BE USED IN PYROTECHNIC PISTOL M-8

Model	*Color(s)*	*No. of Stars*	*Parachute*	*Falling Rate (Ft/Sec)*	*Candlepower*
AN-M37	Red-Red	2	No	Free-falling	25,000
AN-M38	Yellow-Yellow	2	No	Free-falling	20,000
AN-M39	Green-Green	2	No	Free-falling	12,000
AN-M40	Red-Yellow	2	No	Free-falling	25,000 Red 20,000 Yellow
AN-M41	Red-Green	2	No	Free-falling	25,000 Red 12,000 Green
AN-M44	Yellow	1	No	Free-falling	15,000
AN-M45	Green	1	No	Free-falling	30,000

(4) PACKING SIGNALS AND FLARES IN SIGNAL FLARE CONTAINER.—Signals should be packed in the signal flare container with rims down so that identification markings and colors are exposed when the container is opened. A flare is packed in the signal flare container by placing it lengthwise along the tops of the signal ends. Signal flare container A-8 has a capacity of 14 assorted signals and six flares.

(5) GENERAL PRECAUTIONS IN HANDLING SIGNALS AND FLARES USED IN PYROTECHNIC PISTOL M-8.

(a) Handle pyrotechnic ammunition with the same care as any high explosive.

(b) Keep flares and signals free from moisture.

Note

Containers which show signs of dampness or moisture will be opened and if there is any evidence of moisture on the pyrotechnics, they will be destroyed by authorized and experienced personnel.

(c) Disassembly of flares or signals is strictly prohibited.

(d) Flares or signals which are bent or dented shall not be used.

(e) Avoid rough handling, throwing, or dropping of pyrotechnics.

(f) Remove flares and signals from their sealed containers only in such quantities as they are actually needed.

SECTION VI

MATERIALS OF CONSTRUCTION

1. A table listing the part numbers, titles, next assemblies, materials and the prescribed heat treatment will be found on the following pages.

2. The type A17ST rivets are used throughout the airplane except in a few locations where the stress loads require the use of the type D17ST rivets (hard driven). No type DD24ST rivets are used and no substitution of the A17ST for D17ST rivets should take place.

3. The following table contains the Army and Navy specifications for the material most commonly used in this airplane.

Material	*Specification*
Alclad Sheet (24s)	AN-A-13
Aluminum-Alloy Bar	Fed.-QQ-A-354
Aluminum-Alloy Die Casting	AN-QQ-A-366
Aluminum-Alloy Extrusion (shapes)	Fed.-QQ-A-354
Aluminum-Alloy Forging (14 st)	Fed.-QQ-A-367
Aluminum-Alloy Sand Casting (stressed)	AN-QQ-A-390
Aluminum-Alloy Sand Casting (not stressed)	AN-QQ-A-394
Aluminum-Alloy Sheet (24s)	AN-A-12
Aluminum-Alloy Tubing (24s)	Fed.-WW-T-785
Aluminum Bar	Fed.-QQ-A-411
Aluminum Bronze Bar	AN-B-16
Aluminum Bronze Casting	AN-QQ-B-672
Aluminum Bronze Casting	AN-QQ-B-671
Aluminum Sheet (3s)	Fed.-QQ-A-359
Aluminum Tubing (2s)	Fed.-WW-T-783
Aluminum Tubing (52s)	Fed.-WW-T-787
Brass Bar	Fed.-QQ-B-611
Brass Bar (Naval)	Fed.-QQ-B-636
Brass Sheet	Fed.-QQ-B-611
Brass Tubing	Fed.-WW-T-791
Copper Bar	AAF-11070
Copper Bar	Fed.-QQ-C-501
Copper Sheet	AAF-11070
Copper Sheet	Fed.-QQ-C-501
Copper Tubing (Soft Annealed)	Fed.-WW-T-799
Corrosion-Resistant Steel Bar	AN-QQ-S-771
Corrosion-Resistant Steel Forging	Navy-46-S-26 (Int)
Corrosion-Resistant Steel Sheet (Stab.)	AN-QQ-S-757
Corrosion-Resistant Steel Sheet (Unstab)	AN-QQ-S-772
Corrosion-Resistant Steel Tubing (Stab.)	AN-WW-T-858
Corrosion-Resistant Steel Tubing (Unstab)	AN-WW-T-855
C.M. Steel Bar (X4130)	AN-QQ-S-684
C.M. Steel Bar (X4140)	AN-QQ-S-752
C.M. Steel Forging (WD4135)	AC-57-107-D
C.M. Steel Forging (X4140)	AN-QQ-S-752
C.M. Steel Sheet (X4130)	AN-QQ-S-685
C.M. Steel Tubing (4130)	AN-WW-T-850
Gun Metal Bronze (Red Brass) Casting	Fed.-QQ-B-691
Magnesium-Alloy Bar (Dow-M)	AAF-11336
Magnesium-Alloy Bar (Dow-J-1)	AAF-11335
Magnesium-Alloy Die Casting	AAF-11319
Magnesium-Alloy Extrusion (Dow-J-1)	AAF-11335
Magnesium-Alloy Permanent Mold Casting (Dow-C)	AAF-11349
Magnesium-Alloy Sand Casting (Dow-H-HT)	AN-QQ-M-56
Magnesium-Alloy Sheet (Dow-MA and MH	AAF-11339
Magnesium-Alloy Tubing (Dow-J-1)	AAF-11332
Maganese Bronze	Fed.-QQB-726
Nickel Steel Bar (4340)	AN-QQ-S-756
Steel Bar (Low-Carbon)	AN-QQ-S-646
Steel Cable (Flexible Preformed)	AN-RR-C-43
Steel Cable (Nonflexible)	AN-C-76
Steel Forging (Low-Carbon)	AN-QQ-S-646
Steel Sheet (Low-Carbon)	AN-S-11 (under 1/4-inch)
Steel Sheet (Low-Carbon)	AN-QQ-S-676 (1/4-inch and over)

Note

Because very often the part number of the part in question is not known by repair personnel, following this list of parts is an alphabetical list of the same units to aid in determining the correct part number.

HEAT TREATED PARTS

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
110845	Key—Control column wheel	5110598	C.M. Steel Bar	None
116500	Bushing	1117049	Nickel Steel Bar	Raw Stock 125,000 to 145,000 psi
119032	Pin—Floor attaching dog	119311 1012947 4115734 4115735	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
139187	Clevis—Automatic pilot servo unit	5142884 5116435	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi
164268	Lug—Engine mount	168243 5141024	C.M. Steel Forging	After Fabrication Normalized
1004306-1	Swivel—Cowling flap actuating rod connecting	1119086 1119099 1119730	C.M. Steel Forging	After Fabrication Normalized
1005410	Piston—Hydraulic pressure regulating valve	4005434	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1007327	Shaft—Power brake control valve center	5007340 1111904 1139240 5110504	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1007328	Shaft—Power brake control valve outer	5007340	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1014376-1	Eyebolt—Rod end	1014376 118147-1	C.M. Steel Forging	After Fabrication 125,000 to 145,000 psi
1014377-1	End—Rod	1118149-1	C.M. Steel Forging	After Fabrication 125,000 to 145,000 psi
1016496-1	Seat—Hydraulic system relief valve	272778	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1024867	Piston—Power brake control valve	5007340	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
1024891	Guide—Rudder pedal lock release	5118930 5118930-1	Low-Carbon Steel Bar	None
1024895	Pin—Rudder pedal lock	5118930 5118930-1	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1024896	Pin—Rudder pedal	5118930 5118930-1	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1024900	Tube—Rudder pedal torque	5118930 5118930-1	C.M. Steel Tubing	Raw Stock Normalized
1024901-1	Pin—Rudder pedal spring retainer	5118930 5118930-1	C.M. Steel Sheet	After Fabrication 150,000 to 170,000 psi
1024901-2	Strap—Rudder pedal spring retainer pin assembly	5118930	C.M. Steel Bar	After Fabrication 150,000 to 170,000 psi
1026296	Arm—Rudder pedal lock	1024900	C.M. Steel Forging	After Fabrication Normalized
1030901	Stop—Tail pipe inlet end support	5141551	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1043379	Housing—Engine mount shock bushing	1116576 1116575	C.M. Steel Forging	After Fabrication Normalized
1046452	Bolt—9-inch spherical hydraulic pressure tank	5133124	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1080907	End—1/4 x 28 flash welded engine control rod	2032516	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1085484	End—5/16 x 24 flash welded type control rod	2085485	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1111904	Link—Turnbuckle connecting	5110504 5110504-1 5110547	C.M. Steel Forging	After Fabrication Normalized
1112389	Ring—Floor tie-down	5139859 5110545 5113037 5114488 5114489	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
1112830	Nut—Retracting link adjusting	5113038	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi
1112831	Sleeve—Retracting strut	2113397	C.M. Steel Tubing	After Fabrication 125,000 to 145,000 psi
1113280	Bolt—Landing-gear upper attaching	5110568 5203619	C.M. Steel Bar	After Fabrication 160,000 to 180,000 psi
1113433	Washer—Retracting strut ring	5110586	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1113462	Bolt—Attaching ring	4113465	C.M. Steel Bar	Raw Stock Hot Rolled and Normalized
1113463	Clip—Attaching ring	4113465	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1113780	Stud—Wing station 111 landing-gear latch lower	4113779	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1113781	Stud—Wing station 111 landing-gear latch upper	4113779	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1114313	Link—Cowling flap to actuating lever connecting	5113759 5113759-1 5141800 5141800-1	C.M. Steel Forging	After Fabrication Normalized
1114937	Clip—Rudder bus cable spring	3114941	C.M. Steel Sheet	After Fabrication Normalized
1114940	Lug—Rudder stop cable	3114941	C.M. Steel Sheet	After Fabrication Normalized
1115031	Fitting—Engine mount tube end small	2115030 2141071	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1115032	Fitting—Engine mount tube end large	2141071 2115030	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1115062	Plate—Safety belt attachment	5110563	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1115128	Spacer—Antidrag ring nose toggle	2114574	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1115192	Rod—Pilot's seat adjustment lock	5115218 5115218-1	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1115193	Rod—Pilot's seat adjusting connecting	5115218 5115218-1	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1115194	Pin—Pilot's seat arm rest hinge	5115218 5115218-1	C.M. Steel Tubing	Raw Stock Normalized

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
1115371	Fitting—Tail pipe station 200-3/8	5115227 5115227-1	C.M. Steel Forging	None
1115476	Bolt Assembly—Forward baggage compartment chain door	5115175	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1115671	Bolt—Aileron outboard hinge	5205212 5110501 5141401	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1115703	Tube—Pilot's seat slide outboard	5115217	C.M. Steel Tubing	Raw Stock Normalized
1115707	Bolt—Pilot's seat slide special eye	5115742 5115742-1	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1115708	Support—Pilot's seat slide roller adjustment	5115742 5115742-1	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1115710	Plunger—Pilot's seat slide	5115742 5115742-1	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1115712	Bracket—Pilot's seat slide control wheel	5115742 5115742-1	C.M. Steel Sheet	After Fabrication Normalized
1115713	Tube—Pilot's seat slide inboard	5115217	C.M. Steel Tubing	Raw Stock Normalized
1115795	Plug—Tail wheel axle	1115797	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi
1115806	Pin—Tail wheel fork shock absorber attaching	5115221	C.M. Steel Tubing	After Fabrication 180,000 to 200,000 psi
1115818	Screw—Tail wheel shock absorber pin lock	5115221	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi
1115961	Angle—Cargo loading door lock spring	5115216	C.M. Steel Sheet	Raw Stock 125,000 to 145,000 psi
1115964	Shaft—Cargo loading door lock	5115216	C.M. Steel Tubing	Raw Stock Normalized
1116115	Bolt—Engine mount attaching	5141413 5110571	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1116180	Screw—Aileron, elevator and rudder tab, control crank	5115229	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi
1116233	Latch—Automatic mixture control	4191523 4115347 4115346	C.M. Steel Bar	After Fabrication 180,000 to 200,000 psi
1116250	Stop—Propeller pitch control cable	2116733 2115351 2116297	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1116575	Housing—Engine mount shock bushing	5112950 5142055	C.M. Steel Forging	After Fabrication Normalized
1116576	Housing—Engine mount shock bushing front	5112950 5142055	C.M. Steel Forging	After Fabrication Normalized
1116706	Pin—Landing-gear truss dowel	5113697	C.M. Steel Bar	After Fabrication 160,000 to 180,000 psi
1116709	End—Landing-gear compensating arm upper	2116697	C.M. Steel Forging	None
1116718	Bracket—Exhaust tail pipe	5116719 5117674	C.M. Steel Sheet	After Fabrication Normalized
1116738	Bolt—Propeller pitch control idler pulley	5204655 5204655-1 5110573 5110573-1	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1116920	Screw—Retracting strut packing nut	5110586	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1116921	Dashpot—Retracting strut piston	5110586	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1116924	Nut—Landing-gear retracting strut housing check	5110586 5116910	C.M. Steel Tubing	Raw Stock Normalized
1116954	Plate—Landing-gear shock strut upper bolt locking	5110568 5203619	C.M. Steel Sheet	Raw Stock Normalized
1117002	Rod—Retracting strut piston	2113397	C.M. Steel Tubing	Raw Stock Normalized
1117023	Bolt—Aileron cable chain attaching special	3113769	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1117024	Stop—Control column aileron chain	3113769	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
1117059	Bolt—Landing-gear latch handle	5110570	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1117064	Bushing—Landing-gear valve latch dog	5118294	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1117078	Bolt—Landing-gear upper truss attaching	5203619 5110568	C.M. Steel Bar	After Fabrication 150,000 to 170,000 psi

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
1117080-1	Bolt—Landing-gear latch connecting rod eye	1117080 (5110570)	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1117116	Tube—Control column torque	5110598	C.M. Steel Tubing	Raw Stock Normalized
1117217	End—Cowling flap actuating RH rod fork	5113759 5113759-1 5141800 5141800-1	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1117281	End—Oil cooler tube angle	2117340	C.M. Steel Forging	After Fabrication Normalized
1117356	Support—Window locking	5117199 5117199-1	C.M. Steel Sheet	Raw Stock Normalized
1117548	Plug—Engine mount fitting	4114541 4114541-1 4114540 4114540-1	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1117621	Plug—Retracting strut piston	2113397	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1117628	Hook—Antidrag ring fastener	2114574	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
1117632	Pin—Antidrag ring fastener	2114574	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1117634	Pin—Antidrag ring fastener	2114574	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1117771	Bolt—Engine mount attaching	5141413 5110571	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1117813	Plate—Disconnect valve lock	4204304 4204212 4143843 4117577	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1117961-4	End—Aileron tab control rod	1117961	Nickel Steel Bar	Raw Stock 125,000 to 145,000 psi
1118044-1	Rod—Wing flap operating piston	1118044-2	C.M. Steel Tubing	After Fabrication 140,000 to 160,000 psi
1118052	Collar—Wing flap strut shear	5117384	C.M. Steel Tubing	Raw Stock Normalized
1118084	End—Aileron tab push rod adjustable	1117961	Nickel Steel Bar	Raw Stock 125,000 to 145,000 psi
1118130	Bolt—Oil dilution solenoid "U"	5141344	C.M. Steel Bar	After Fabrication Normalized
1118131	End—Aileron tab control rear push rod	1117961	Nickel Steel Bar	Raw Stock 125,000 to 145,000 psi
1118150-4	Screw Assembly—Tab control	1118150	Corrosion-resistant Steel Bar	None
1118155	Link—Propeller pitch control	5114462 5114463	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1118198	Socket—Tab control	2118148	Nickel Steel Bar	Raw Stock 125,000 to 145,000 psi
1118202	Socket—Tab control adjustable	2118148	Nickel Steel Bar	Raw Stock 125,000 to 145,000 psi
1118203	Ball—Tab control universal	2118148	Nickel Steel Bar	Raw Stock 125,000 to 145,000 psi
1118274-1	Plate—Rudder stop link	1118274	C.M. Steel Sheet	After Fabrication 125,000 to 150,000 psi
1118274-2	Tube—Rudder stop link	1118274	C.M. Steel Tubing	After Fabrication 125,000 to 150,000 psi
1118277	Sleeve—Brake pedal torque tube arm	5116804	C.M. Steel Tubing	Raw Stock Normalized
1118284	Arm—Parking brake rod operating	5110547	Low-Carbon Steel Forging	None
1118288	Arm—Parking brake torque shaft	5110547	Low-Carbon Steel Forging	None
1118290-1	Tube—Pulley bracket stiffener	1118290 (5110547)	C.M. Steel Tubing	After Fabrication Normalized
1118492	Plug—Flap operating tube connection	1118550 2118473 2118500	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1118494	Screw—Flap operating tube connecting	2118473	Nickel Steel Bar	Raw Stock 125,000 to 145,000 psi
1118525	Bushing—Wing flap universal bolt	1118550	Nickel Steel Bar	Raw Stock 125,000 to 145,000 psi

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
1118528	Link—Wing flap operating	2118498	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1118529	Clevis—Wing flap operating	2118498	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1118550-4	Tube—Wing flap operating joint	1118550	C.M. Steel Tubing	Raw Stock Normalized
1118652	Pin—Propeller pitch control pulley	2116733 2116733-1	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1118703	Spindle—Carburetor air intake valve operating	4118710	C.M. Steel Tubing	Raw Stock Normalized
1118803	Plug—Special 12x36 lubricator	1118150	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1118921	Ring—Rudder pedal bearing retainer snap	5118931 5118928 5118929	C.M. Steel Tubing	After Fabrication 160,000 to 180,000 psi
1118998	Link—Auto-pilot shut-off cable	2118818	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1119087	Rod—Cowling flap tie	5113759 5113759-1	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi
1119088	End—Cowling flap removable coupling	5141800 5141800-1 5113759 5113759-1	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi
1119092	Body—Cowling flap removable coupling	1119089	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1119098	Bushing—Cowling flap operating cylinder	2116310	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1119763	Bolt—Brake lever clamp	5203833 5141943 5110553	C.M. Steel Bar	After Fabrication 150,000 to 170,000 psi
1119936	Bolt—Main door latch	5119956	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1119938	Bearing—Main door latch upper	5119956	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1119939	Bearing—Main door latch lower	5119956	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1119967	Plate—Main door lower striker	5110530 5139460 5142704	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1119968	Plate—Main door upper striker	5110530 5139460 5142704	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1119974	Stop—Main door latch	5119956	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1130056	Bearing—Antidrag ring bracket	4118145	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1130135	Bolt—Main cargo door latch	1142923	C.M. Steel Forging	After Forging Normalized
1130146	Plate—Cargo door latch striker	5110530	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1130162	Pin—Safety latch	4130166 4130123	Drill Rod	None
1130451	Plate—Main cargo door spring latch striker	5118687 5139261 5142672	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1130474	Plate—Main cargo door aft striker	5118687 5139261 5142672	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
1131032	Bolt—1/4 x 8 x 32 eye	5114542 5115175	Bessemer Steel Bar	None
1132403	Pin—Litter support clamp	5139541 5139541-1 5132411	Steel Drill Rod	None
1132405	Pin—Litter spring attaching	5139541 5139541-1 5132411	Steel Drill Rod	None
1132540	Pin—Upper litter inboard support	2132630	Steel Drill Rod	None
1133128	Bolt—Spherical hydraulic pressure tank hanger	5133124	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
1137626	End—1/4 x 28 flash welded type	4119922	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1139096	Bolt—Propeller pitch control idler special	5114462 5114463	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
1139240	Link—Elevator Horn connecting	5110547	C.M. Steel Forging	After Forging Normalized
1139286	Stud—Special	5115720 5113727	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi
1139371	Connector—Retracting strut special	5140045	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1139420	Bushing—Brake torque tube lock stop	5110547	C.M. Steel Bar	After Fabrication 150,000 to 170,000 psi
1139485	Plate—Tail mooring anchor	5110533 5139976 5142193 5142309	C.M. Steel Sheet	Raw Stock Normalized
1139617	Pin—Cargo door station 535 hinge	2140084	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1139791	Trunnion—Fuel tank strap	5139644	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1140037	Collar—Forward cargo door panel latch shaft	4140103	C.M. Steel Tube	Raw Stock Normalized
1140551	Eyebolt—Glider tow	5140604	C.M. Steel Sheet	After Fabrication 170,000 to 190,000 psi
1140679	Rod—Landing-gear shock strut restraining link	2140682	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1140680-2	Boss—Landing-gear shock strut restraining link block assembly	1140680 (2140682)	C.M. Steel Bar	After Fabrication 150,000 to 180,000 psi
1140680-4	Plate—Landing-gear shock strut restraining link block assembly	1140680 (2140682)	C.M. Steel Bar	After Fabrication 150,000 to 180,000 psi
1141930	Spacer—Glider tow eyebolt	5140604	C.M. Steel Bar	Raw Stock Normalized
1142586	Pin—Rear cargo door hinge	5142672	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1143132	Pin—LH propeller pitch control pulley	2116733	C.M. Steel Bar	None
1143666	Link—Tail pipe attaching female	1173233	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1145656	End—Tail pipe attaching link male	1145658 (5141551)	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1145657	End—Tail pipe attaching link female	1145658 (5141551)	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1173234	End—Tail pipe attaching link	1173233	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1202462	End—Forward door latch rod	4202486	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1202463	Rod—Door latch coupling	5119956	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1202464	Bolt—Forward main door top latch	5119956	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1202673	End—Forward door latch rod upper	4202486	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1203892	Ring—Cargo anchor	5114488 5139859 5113037 5113038 5114489	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
1204010	Bushing—Hydraulic compensator adapter	4204011	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
2006235	Lock—Tail wheel spindle	2115841	C.M. Steel Forging	After Fabrication 125,000 to 145,000 psi
2007339-1	Lever—Power brake control valve light operating	5143257	C.M. Steel Bar	After Fabrication 180,000 to 200,000 psi
2007339-3	Bracket—Power brake control valve light operating lever	2007339	C.M. Steel Forging	After Fabrication Normalized
2085485-1	Tube—5/16 x 24 flash welded type rod assembly	5204655	C.M. Steel Tubing	Raw Stock Normalized
2112103	Lug—Engine tie-down	5112968 5112642	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
2112582	Fitting—Tie-down front	5112642 5112968	C.M. Steel Forging	After Fabrication Normalized
2112874	Arm—Cargo deflector sheave supporting	4140685 4113284	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
2113139	Bolt—Cargo deflector arm supporting eye	4113284	C.M. Steel Bar	After Fabrication 160,000 to 180,000 psi
2114316	Lever—Cowling flap actuating special	5141800 5141800-1 5113759 5113759-1	C.M. Steel Forging	After Fabrication Normalized

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
2114317-2	Lever—Cowling flap actuating	5141800 5141800-1 5113759 5113759-1	C.M. Steel Forging	After Fabrication Normalized
2114391	Lug—Station 351-1/2 engine tie-down	5112968	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
2114539	Fitting—Engine mount upper	5141024 5110599	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
2114850	Hook—Safety belt	2114852	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
2115030	Tube Assembly—Engine mount	5110599 5141024	C.M. Steel Tubing	Raw Stock Normalized
2115035	Toggle—Antidrag ring nose	2114574	C.M. Steel Forging	After Fabrication Normalized
2115284	End—Tail wheel shock absorber piston clevis	3115289	C.M. Steel Bar	After Fabrication 125,000 to 145,000 psi
2115286	Head—Tail wheel shock absorber piston	3115048	C.M. Steel Bar	After Fabrication 150,000 to 170,000 psi
2115393	Fitting—Rudder torque	5115212	C.M. Steel Sheet	Raw Stock Normalized
2116125	Screw—Control pedestal elevator tab indicator lead	5116148	C.M. Steel Bar	None
2116159	Shaft—Aileron and rudder tab control	5115229	C.M. Steel Tubing	Raw Stock Normalized
2116354	Bolt—Aileron hinge eye	5110501 5141401	Nickel Steel Bar	After Fabrication 125,000 to 145,000 psi
2116475	Bracket—Wing attach angle fairing	5116323	Low-Carbon Steel Forging	None
2116928	Head—Landing-gear retracting strut piston	2113397	C.M. Steel Bar	After Fabrication Normalized
2116964	Brace Assembly—Landing-gear bungee toggle	5110568	C.M. Steel Tubing	After Fabrication Normalized
2117068-1	Tube—Landing-gear latch connecting rod	2117068	C.M. Steel Tubing	After Fabrication Normalized
2117172	Support—Oil cooler upper	5141504 5110576	C.M. Steel Forging	After Fabrication Normalized
2117361	Bar—Window locking	5117199 5117199-1	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
2118313	Stop—Brake torque tube lock	5110547	C.M. Steel Forging	After Fabrication 180,000 to 200,000 psi
2118399	Nut—Wing flap strut external packing	5117384	C.M. Steel Tubing	After Fabrication 125,000 to 145,000 psi
2118473-2	Tube—Outer wing flap operating	2118473 5110504	C.M. Steel Tubing	Raw Stock Normalized
2118473-10	Tube—Outer wing flap operating	2118473 5110504	C.M. Steel Tubing	Raw Stock Normalized
2118500-2	Tube Assembly—Wing center section flap operating	2118500-4	C.M. Steel Tubing	After Welding 125,000 to 145,000 psi
2119391	Hinge—Main door female	5110530 5139460 5142704	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
2119392	Hinge—Main door	2119464 2139639 2119391	C.M. Steel Forging	After Fabrication Normalized
2119464	Hinge—Main door male	5118741 5140039 5118687 2141346	C.M. Steel Forging	After Fabrication 125,000 to 145,000 psi
2119948	Link—Antidrag ring toggle female	4118464	C.M. Steel Forging	After Fabrication Normalized
2119949	Link—Antidrag ring toggle male	4118464	C.M. Steel Forging	After Fabrication Normalized
2119950	Bracket—Antidrag ring rear	4118402	C.M. Steel Forging	After Fabrication Normalized
2119982	Crank—Main door latch bell	5119956	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
2119983	Bell Crank—Main door latch	2119982	C.M. Steel Forging	After Fabrication Normalized
2130736	Stop—Elevator	5130750	C.M. Steel Forging	After Fabrication Normalized
2131256	Tube—Landing-gear mechanical latch torque	2117067	C.M. Steel Tubing	After Fabrication 125,000 to 145,000 psi

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
2132722	Tube—Upper horizontal litter support	5110541	C.M. Steel Tubing	After Fabrication 125,000 to 145,000 psi
2139226-10	Plug—Parachute pack rack support tube assembly	2139226	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
2139312	Shaft—Parachute pack rack lever	5139300 5139301 5139302	C.M. Steel Tubing	After Fabrication 150,000 to 170,000 psi
2139321	Shaft—Parachute pack rack rear	5139300 5139301 5139302	C.M. Steel Tubing	After Fabrication 150,000 to 170,000 psi
2139448	End—Parachute pack rack lever shaft	5139300 5139301 5139302	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
2139639	Hinge—Cargo door station 535 female	5139460	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
2139720-2	Tube—Parachute pack rack forward center brace	2139720	C.M. Steel Tubing	Raw Stock Normalized
2139796	Chock—Parachute pack rack adjustable	2139794 4139816 5141146 5141147 5141148	C.M. Steel Tubing	Raw Stock Normalized
2139914-2	Tube—Rear center brace	2139914	C.M. Steel Tubing	Raw Stock Normalized
2140007-4	Plate—Forward cargo door latch shaft	2140007	C.M. Steel Sheet	Raw Stock Normalized
2140008	Plate—Forward cargo door lower striker	5140039	C.M. Steel Sheet	Raw Stock Normalized
2140008-1	Plate—Forward cargo door lower striker	5140039	C.M. Steel Sheet	Raw Stock Normalized
2140009	Plate—Forward cargo door upper striker	5140039	C.M. Steel Sheet	Raw Stock Normalized
2140009-1	Plate—Forward cargo door upper striker	5140039	C.M. Steel Sheet	Raw Stock Normalized
2140010-4	Plate—Forward cargo door panel rod	2140010 (5140038)	C.M. Steel Sheet	Raw Stock Normalized
2140021	Knob—Forward main cargo door panel tapered	5140038	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
2140070	Hook—Safety belt	2114850	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
2140272	Ring—Cargo tie-down	5142309 5139976	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
2140409	Bolt—Cargo primary defector eye	5140543	C.M. Steel Bar	After Fabrication 160,000 to 180,000 psi
2140411	Shaft—Deflector bracket	5140543	C.M. Steel Bar	After Fabrication 160,000 to 180,000 psi
2140545	Fitting—Tube end station 718-3/8 glider tow	3140567	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
2140550	Fitting—Glider tow tube end	3140567	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
2140798-2	Tube—Cargo door station 535 female lower hinge	2140798 (5139460)	C.M. Steel Tubing	After Fabrication 125,000 to 155,000 psi
2140799-2	Tube—Cargo door station 535 female upper hinge	2140799	C.M. Steel Tubing	Raw Stock Normalized
2140803-2	Bar—Cargo door station 535 male upper hinge	2140803	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
2140804-2	Bar—Cargo door station 535 male lower hinge	2140804	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
2141071	Tube—Engine mount welded	5141024	C.M. Steel Tubing	Raw Stock Normalized
2142545	Bracket—Rear cargo door hinge	5142704	C.M. Steel Sheet	Raw Stock Normalized
2203315	Lever Assembly—Lower flap actuating	2203361-2	Low-Carbon Steel Forging	None
2203360-2	Support Assembly—Cowling flap and actuating lever	5141800 5141800-1	Low-Carbon Steel Forging	None
2203465-2	Lever Assembly—Cowling flap actuating	5141800 5141800-1	Low-Carbon Steel Forging	None
3113696-2	Tube—Landing-gear truss strut	3113696	C.M. Steel Tubing	After Fabrication 150,000 to 180,000 psi
3115287	Body—Tail wheel shock absorber	3115289	C.M. Steel Tubing	After Fabrication Normalized and straighten

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
3115855	Tube—Tail wheel spindle	3115856	C.M. Steel Tubing	After Fabrication 180,000 to 200,000 psi
3132672	Tube—Horizontal litter support	5110541	C.M. Steel Tubing	After Fabrication 125,000 to 145,000 psi
3140567-2	Tube—Glider tow welded	3140567	C.M. Steel Tubing	After Fabrication 150,000 to 170,000 psi
4112833	Bolt—Retracting strut end eye	5110586	C.M. Steel Forging	After Fabrication 180,000 to 200,000 psi
4113464	Ring—Pulley attaching	4113465	C.M. Steel Sheet	After Fabrication 125,000 to 145,000 psi
4113692	End—Landing-gear truss strut	3113696	C.M. Steel Forging	After Forging Normalized
4113694	End—Landing-gear truss strut lower	3113696	C.M. Steel Forging	After Forging Normalized
4114540-2	Fitting—Engine mount upper wide	5141024 5110599	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
4114540-3	Fitting—Engine mount upper wide	5110599 5141024	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
4114541	Fitting—Engine mount lower	5141024 5110599	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
4115639-2	Tube—Cowling attachment outboard upper bracket	4115639 4115639-1	C.M. Steel Tubing	After Fabrication Normalized
4115639-4	Tube—Cowling attachment outboard upper bracket	4115639 4115639-1	C.M. Steel Tubing	After Fabrication Normalized
4115643-2	Tube—Cowling attachment outboard upper bracket	4115643 4115643-1	C.M. Steel Tubing	After Fabrication Normalized
4115643-4	Tube—Cowling attachment outboard upper bracket	4115643 4115643-1	C.M. Steel Tubing	After Fabrication Normalized
4115858	Lug—Tail wheel spindle upper	3115856	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
4115859	Lug—Tail wheel spindle lower	3115856	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
4115860	Collar—Tail wheel spindle lock	3115856	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
4119309-2	Tube—Cowling attachment lower support	4119309	C.M. Steel Tubing	After Fabrication Normalized
4119951	Lever—Antidrag ring toggle	4118402	C.M. Steel Forging	After Fabrication Normalized
4119922-2	Tube—Main door latch rod assembly	4119922 (5119956)	C.M. Steel Tubing	Raw Stock Normalized
4132891	Tube—Center horizontal litter support	5110541	C.M. Steel Tubing	After Fabrication 125,000 to 145,000 psi
4139974-2	Plate—Station 450-1/2 to 465-1/2 deflector support tie-in bracket	4139974 (5139975)	C.M. Steel Sheet	After Fabrication 125,000 to 155,000 psi
4139974-4	Tube—Station 450-1/2 to 465-1/2 deflector support tie-in bracket	4139974 (5139975)	C.M. Steel Tubing	After Fabrication 125,000 to 155,000 psi
4139974-6	Plate—Station 450-1/2 to 465-1/2 deflector support tie-in bracket	4139974-6	C.M. Steel Sheet	After Fabrication 125,000 to 155,000 psi
4140516-6	Tube—Glider tow collar	4140516	C.M. Steel Tubing	After Fabrication 150,000 to 170,000 psi
4140591	Fitting—Glider tow outb'd lower	5140604	C.M. Steel Sheet	After Fabrication 165,000 to 185,000 psi
4140592	Fitting Glider tow outb'd upper	5140604	C.M. Steel Sheet	After Fabrication 160,000 to 180,000 psi
4140756	Head—Retracting strut yoke	5116910	C.M. Steel Forging	After Fabrication 125,000 to 145,000 psi
4140786	Cylinder—Landing-gear retracting strut	5116910	C.M. Steel Tubing	After Fabrication 125,000 to 145,000 psi
4202486-2	Tube—Main door latch upper rod assembly	4202486 (5119956)	C.M. Steel Tubing	Raw Stock Normalized
4203388	Fitting—Wing station 111 landing-gear latch	5113288	C.M. Steel Bar and Sheet	After Fabrication Normalized
4203838	Filler—Center section wing spar fuselage attaching fitting	5116641 5113999 5113816	C.M. Steel Bar and Sheet	After Fabrication Normalized
4203891	Ring—Oil cooler rear support	5203252 5203252-1 5203251 5203251-1 5141504 5141504-1	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi

Part No.	*Title*	*Next Assembly*	*Material*	*Heat Treatment*
4203970	Ring—Oil cooler front support	5203252 5203252-1 5203251 5203251-1 5141504 5141504-1	C.M. Steel Bar	Raw Stock 125,000 to 145,000 psi
4204011-2	Tube—Hydraulic compensator adapter assembly	4204011	C.M. Steel Tubing	After Fabrication 125,000 to 145,000 psi
5112594	Column—Landing-gear brace strut	5112599	C.M. Steel Forging	After Fabrication 180,000 to 200,000 psi
5112598-2	Leg—Landing-gear rear brace strut	5112599	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
5114203	Guide—Landing-gear latch	5110570	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
5115027	Ring—Engine mount upper half	5110599	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
5115028	Ring—Engine mount lower half	5110599	C.M. Steel Forging	After Fabrication 125,000 to 155,000 psi
5115162-1	Stock Assembly—Elevator	5115162	C.M. SteellTubing	Raw Stock Normalized
5115217-5	Stop—Pilot's seat	5115217	C.M. Steel Tubing	Raw Stock Normalized
5116804-3	Tube—Brake torque	5116804	C.M. Steel Tubing	Raw Stock Normalized
5116804-4	Tube—Brake torque	5116804	C.M. Steel Tubing	Raw Stock Normalized
5117828	Fitting—Center wing section landing-gear attaching	5116763	C.M. Steel Forging	Before Finish Mach. 160,000 to 180,000 psi
5118595-2	Stock Assembly—Rudder	5118595	C.M. Steel Tubing	Raw Stock Normalized
5132626	Brace—Landing-gear truss	5113106	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
5139237	Brace—Landing-gear truss taper web	5139238	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
5139237-1	Brace—Landing-gear truss taper web	5139238	C.M. Steel Forging	After Fabrication 150,000 to 180,000 psi
5139545-2	Tube—Inclined litter	5139545-6 (5110541)	C.M. Steel Tubing	Raw Stock Normalized
5139545-4	Tube—Inclined litter	5139545-6 (5110541)	C.M. Steel Tubing	Raw Stock Normalized
5140448	Ring—LH lower flash welded engine mount	5140725	C.M. Steel Forging	After Fabrication Normalized
5140449	Ring—RH lower flash welded engine mount	5140725-4	C.M. Steel Forging	After Fabrication Normalized
5140450	Ring—LH upper flash welded engine mount	5140726-2	C.M. Steel Forging	After Fabrication Normalized
5140451	Ring—RH upper flash welded engine mount	5140726-4	C.M. Steel Forging	After Fabrication Normalized
5141024	Mount Assembly—Welded type engine	5205673 5205673-1 5203256 5203256-1 5141412 5141412-1 5110572 5110572-1	C.M. Steel Tubing and Sheet	Raw Stock Normalized

ALPHABETICAL PARTS LIST

Part Name	*Part No.*
Angle—Cargo loading door lock spring	1115961
Arm—Cargo deflector sheave supporting	2112874
Arm—Parking brake rod operating	1118284
Arm—Parking brake rod operating	1118284-1
Arm—Parking brake torque shaft	1118288
Arm—Rudder pedal lock	1026296
Ball—Tab control universal	1118203
Bar—Cargo door station 535 male lower hinge	2140804-2
Bar—Cargo door station 535 male upper hinge	2140803-2
Bar—Window locking	2117361
Bearing—Antidrag ring bracket	1130056
Bearing—Main door latch lower	1119939
Bearing—Main door latch upper	1119938
Bellcrank—Main door latch	2119983
Body—Cowling flap removable coupling	1119092
Body—Tail wheel shock absorber	3115287
Brace Assembly—Landing-gear bungee toggle	2116964
Brace—Landing-gear truss	5132626
Brace—Landing-gear truss taper web	5139237
Brace—Landing-gear truss taper web	5139237-1
Bracket—Antidrag ring rear	2119950
Bracket—Power brake control valve light operating lever	2007339-3
Bracket—Wing attachment angle fairing	2116475
Bushing	116500
Bushing—Brake torque tube lock stop	1139420
Bushing—Cowling flap operating cylinder	1119098

Part Name	*Part No.*
Bushing—Hydraulic compensator adapter	1204010
Bushing—Landing-gear valve latch dog	1117064
Bushing—Wing flap universal bolt	1118525
Bracket—Exhaust tail pipe	1116718
Bracket—Pilot's seat slide control wheel	1115712
Bracket—Rear cargo door hinge	2142545
Bracket—Rear cargo door hinge	2142545-1
Bolt—Aileron cable chain attaching special	1117023
Bolt—Aileron hinge eye	2116354
Bolt—Aileron outboard hinge	1115671
Bolt Assembly—Fwd baggage compt chain door	1115476
Bolt—Attaching ring	1113462
Bolt—Brake lever clamp	1119763
Bolt—Cargo cable primary deflector eye	2140409
Bolt—Cargo deflector arm supporting eye	2113139
Bolt—Engine mount attaching	1117771
Bolt—Engine mount attaching	1116115
Bolt—¼ x 8 x 32 eye	1131032
Bolt—Forward main door top latch	1202464
Bolt—Landing-gear latch connecting rod eye	1117080-1
Bolt—Landing-gear latch handle	1117059
Bolt—Landing-gear upper attaching	1113280
Bolt—Landing-gear upper truss attaching	1117078
Bolt—Main cargo door latch	1130135
Bolt—Main door latch	1119936
Bolt—Oil dilution solenoid "U"	1118130
Bolt—Pilot's seat slide special eye	1115707
Bolt—Propeller pitch control idler pulley	1116738
Bolt—Propeller pitch control idler special	1139096
Bolt—Retracting strut end eye	4112833
Bolt—9-inch spherical hydraulic pressure tank	1046452
Bolt—Spherical hydraulic pressure tank hanger	1133128
Boss—Landing-gear shock strut restraining link block assembly	1140680-2
Chock—Parachute pack rack adjustable	2139796
Clevis—Automatic pilot servo unit	139187
Clevis—Wing flap operating	1118529
Clip—Rudder bus cable spring	1114937
Clip—Attaching ring	1113463
Collar—Forward cargo door panel latch shaft	1140037
Collar—Tail wheel spingle lock	4115860
Collar—Wing flat strut shear	1118052
Column—Landing-gear brace strut	5112594
Connector—Retracting strut special	1139371
Crank—Main door latch bell	2119982
Cylinder—Landing-gear retracting strut	4140786
Dashpot—Retracting strut piston	1116921
End—Aileron tab control rear push rod	1118131
End—Aileron tab control rod	1117961-4
End—Aileron tab push rod adjustable	1118084
End—Cowling flap operating RH rod fork	1117217
End—Cowling flap removable coupling	1119088
End—1/4 x 28 flash welded engine control rod	1080907
End—5/16 x 24 flash welded type control rod	1085484
End—1/4 x 28 flash welded type	1137626
End—Forward door latch rod	1202462
End—Forward door latch rod upper	1202673
End—Landing-gear compensating arm upper	1116709
End—Landing-gear truss	4113692
End—Landing-gear truss strut lower	4113694
End—Oil cooler tube angle	1117281
End—Parachute pack rack lever shaft	2139448
End—Rod	1014377-1
End—Tail pipe attaching link	1173234
End—Tail pipe attaching link female	1145657
End—Tail pipe attaching link male	1145656
End—Tail wheel shock absorber piston clevis	2115284
Eyebolt—Glider tow	1140551
Eyebolt—Rod end	1014376-1
Eyebolt—Rod end	1014377-1
Filler—Center section wing spar fuselage attaching fitting	4203838
Fitting—Center wing section ldg-gear attaching	5117828

Part Name	*Part No.*
Fitting—Engine mount tube end large	1115032
Fitting—Engine mount tube end small	1115031
Fitting—Engine mount lower	4114541
Fitting—Engine mount upper	2114539
Fitting—Engine mount upper wide	4114540-2
Fitting—Engine mount upper wide	4114540-3
Fitting—Glider tow outb'd lower	4140591
Fitting—Glider tow outb'd upper	4140592
Fitting—Glider tow tube end	2140550
Fitting—Rudder torque	2115393
Fitting—Tail pipe station 200-3/8	1115371
Fitting—Tie-down front	2112582
Fitting—Tube end station 718-3/8 glider tow	2140545
Fitting—Wing station 111 landing-gear latch	4203388
Guide—Landing-gear latch	5114203
Guide—Rudder pedal lock release	1024891
Head—Landing-gear retracting strut piston	2116928
Head—Retracting strut yoke	4140756
Head—Tail wheel shock absorber piston	2115286
Hinge—Cargo door station 535 female	2139639
Hinge—Main door	2119392
Hinge—Main door female	2119391
Hinge—Main door male	2119464
Hook—Antidrag ring fastener	1117628
Hook—Safety belt	2140070
Hook—Safety belt	2114850
Housing—Engine mount shock bushing	1043379
Housing—Engine mount shock bushing	1116575
Housing—Engine mount shock bushing front	1116576
Key—Control column wheel	110845
Knob—Fwd main cargo door panel tapered	2140021
Latch—Automatic mixture control	1116233
Leg—Landing-gear rear brace strut	5112598-2
Lever—Antidrag ring toggle	4119951
Lever Assembly—Cowling flap actuating	2203465-2
Lever Assembly—Lower flap actuating	2203315
Lever—Cowling flap actuating	2114317-2
Lever—Cowling flap actuating special	2114316
Lever—Power brake control valve light operating	2007339-1
Link—Antidrag ring toggle female	2119948
Link—Antidrag ring toggle male	2119949
Link—Automatic pilot shut-off cable	1118998
Link—Cowl flap to actuating lever connecting	1114313
Link—Elevator horn connecting	1139240
Link—Propeller pitch control	1118155
Link—Tail pipe attaching female	1143666
Link—Turnbuckle connecting	1111904
Link—Wing flap operating	1118528
Lock—Tail wheel spindle	2006235
Lug Assembly—Tail wheel spindle lower	4115859
Lug—Engine mount	164268
Lug—Engine tie-down	2112103
Lug—Station 351-1/2 engine tie-down	2114391
Lug—Rudder stop cable	1114940
Lug—Tail wheel spindle upper	4115858
Mount Assembly—Welded type engine	5141024
Nut—Ldg-gear retracting strut housing check	1116924
Nut—Retracting link adjusting	1112830
Nut—Wing flap strut external packing	2118399
Pin—Antidrag ring fastener	1117632
Pin—Antidrag ring fastener	1117634
Pin—Cargo door station 535 hinge	1139617
Pin—Floor attaching dog	119032
Pin—Landing-gear truss dowel	1116706
Pin—Litter spring attaching	1132405
Pin—Litter support clamp	1132403
Pin—Pilot's seat arm rest hinge	1115194
Pin—Propeller pitch control pulley	1118652
Pin—LH propeller pitch control pulley	1143132
Pin—Rear cargo door hinge	1142586
Pin—Rudder pedal	1024896
Pin—Rudder pedal lock	1024895

Part Name	*Part No.*
Pin—Rudder pedal spring retainer	1024901
Pin—Rudder pedal spring retainer	1024901-1
Pin—Safety latch	1130162
Pin—Tail wheel fork shock absorber attaching	1115806
Pin—Upper litter inboard support	1132540
Piston—Hydraulic pressure regulating valve	1005410
Piston—Power brake control valve	1024867
Plate—Cargo door latch striker	1130146
Plate—Station 450-1/2 to 465-1/2 deflector support tie-in bracket	4139974-2
Plate—Station 450-1/2 to 465-1/2 deflector support tie-in bracket	4139974-6
Plate—Disconnect valve lock	1117813
Plate—Forward cargo door latch shaft	2140007-4
Plate—Forward cargo door panel rod	2140010-4
Plate—Forward cargo door lower striker	2140008
Plate—Forward cargo door lower striker	2140008-1
Plate—Forward cargo door upper striker	2140009
Plate—Forward cargo door upper striker	2140009-1
Plate—Landing-gear shock strut restraining link block assembly	1140680-4
Plate—Landing-gear shock strut upper bolt locking	1116954
Plate—Main cargo door aft striker	1130474
Plate—Main cargo door spring latch striker	1130451
Plate—Main door lower striker	1119967
Plate—Main door upper striker	1119968
Plate—Rudder stop link	1118274-1
Plate—Safety belt attachment	1115062
Plug—Special 12 x 36 lubricator	1118803
Plate—Tail mooring anchor	1139485
Plug—Engine mount fitting	1117548
Plug—Flap operating tube connection	1118492
Plug—Parachute pack rack support tube assembly	2139226-10
Plug—Retracting strut piston	1117621
Plug—Tail wheel axle	1115795
Plunger—Pilot's seat slide	1115710
Ring—Cargo anchor	1203892
Ring—Cargo tie-down	2140272
Ring—Engine mount lower half	5115028
Ring—Engine mount upper half	5115027
Ring—Floor tie-down	1112389
Ring—LH lower flash welded engine mount	5140448
Ring—RH lower flash welded engine mount	5140449
Ring—Rudder pedal bearing retainer snap	1118921
Ring—LH upper flash welded engine mount	5140450
Ring—RH upper flash welded engine mount	5140451
Rod—Cowling flap tie	1119087
Rod—Door latch coupling	1202463
Rod—Landing-gear shock strut restraining link	1140679
Ring—Oil cooler front support	4203970
Ring—Oil cooler rear support	4203891
Ring—Pulley attaching	4113464
Rod—Pilot's seat adjustment lock	1115192
Rod—Pilot's seat adjusting connecting	1115193
Rod—Retracting strut piston	1117002
Rod—Wing flap operating piston	1118044-1
Screw—Aileron elevator and rudder tab control crank	1116180
Screw Assembly—Tab control	1118150-4
Screw—Control pedestal elevator tab indicator lead	2116125
Screw—Flap operating tube connecting	1118494
Screw—Retracting strut packing nut	1116920
Seat—Hydraulic system relief valve	1016496-1
Stop—Control column aileron chain	1117024
Stud—Special	1139286
Screw—Tail wheel shock absorber pin lock	1115818
Shaft—Aileron and rudder tab control	2116159
Shaft—Cargo loading door lock	1115964

Part Name	*Part No.*
Shaft—Deflector bracket	2140411
Shaft—Parachute pack rack lever	2139312
Shaft—Parachute pack rack rear	2139321
Shaft—Power brake control valve center	1007327
Shaft—Power brake control valve outer	1007328
Sleeve—Brake pedal torque tube arm	1118277
Sleeve—Retracting strut	1112831
Socket—Tab control	1118198
Socket—Tab control adjustable	1118202
Spacer—Antidrag ring nose toggle	1115128
Spacer—Glider tow eyebolt	1141930
Spindle—Carburetor air intake valve operating	1118703
Stock Assembly—Elevator	5115162-1
Stock Assembly—Rudder	5118595-2
Stop—Brake torque tube lock	2118313
Stop—Control column aileron chain	1117024
Stop—Elevator	2130736
Stop—Main door latch	1119974
Stop—Pilot's seat	5115217-5
Stop—Propeller pitch control cable	1116250
Stop—Tail pipe inlet end support	1030901
Strap—Rudder pedal spring retainer pin assembly	1024901-2
Stud—Wing station 111 landing-gear latch lower	1113780
Stud—Wing station 111 landing-gear latch upper	1113781
Support Assembly—Cowling flap and actuating lever	2203360-2
Support—Oil cooler upper	2117172
Support—Pilot's seat slide roller adjustment	1115708
Support—Window locking	1117356
Swivel—Cowling flap actuating rod connecting	1004306-1
Toggle—Antidrag ring nose	2115035
Trunnion—Fuel tank strap	1139791
Tube Assembly—Engine mount	2115030
Tube Assembly—Wing center section flap operating	2118500-2
Tube—Brake torque	5116804-3
Tube—Brake torque	5116804-4
Tube—Cargo door station 535 female lower hinge	2140798-2
Tube—Cargo door station 535 female upper hinge	2140799-2
Tube—Center horizontal litter support	4132891
Tube—Control column torque	1117116
Tube—Cowling attachment lower support	4119309-2
Tube—Cowling attachment outboard upper bracket	4115639-2
Tube—Cowling attachment outboard upper bracket	4115639-4
Tube—Cowling attachment outboard upper bracket	4115643-2
Tube—Cowling attachment outboard upper bracket	4115643-4
Tube—Station 450-1/2 to 465-1/2 deflector support tie-in bracket	4139974-4
Tube—Engine mount welded	2141071
Tube—5/16 x 24 flash welded type rod assembly	2085485-1
Tube—Glider tow collar	4140516-6
Tube—Glider tow welded	3140567-2
Tube—Horizontal litter support	3132672
Tube—Hydraulic compensator adapter assembly	4204011-2
Tube—Inclined litter	5139545-2
Tube—Inclined litter	5139545-4
Tube—Landing-gear latch connecting rod	2117068-1
Tube—Landing-gear mechanical latch torque	2131256
Tube—Landing-gear truss strut	3113696-2

Part Name	*Part No.*
Tube—Main door latch rod assembly	4119922-2
Tube—Main door latch upper rod assembly	4202486-2
Tube—Outer wing flap operating	2118473-10
Tube—Outer wing flap operating	2118473-2
Tube—Parachute pack rack forward center brace	2139720-2
Tube—Pilot's seat slide inboard	11157[illegible]3
Tube—Pilot's seat slide outboard	1115703
Tube—Pulley bracket stiffener	1118290-1
Tube—Rear center brace	2139914-2
Tube—Rudder pedal torque	1024900
Tube—Rudder stop link	1118274-2
Tube—Tail wheel spindle	2115855
Tube—Upper horizontal litter support	2132722
Tube—Wing flap operating joint	1118550-4
Washer—Retracting strut ring	1113433

SECTION VII

FINISH SPECIFICATIONS

1. GENERAL.

a. The service life of any structure depends upon its protective coating and the care which it receives. Most of the alloys used in the construction of the C-47 and C-47A airplanes are subject to corrosion in their unprotected state. Corrosion takes place quicker in damp coastal climates; therefore, under such climatic conditions all scratches, abrasions, or marred finish surfaces must be cared for as soon as possible to avoid undue corrosion and extensive repairs. Prompt cleaning and application of a new protective coating to injured surfaces will prevent corrosion and insure proper care.

b. Whenever the peculiarity of a particular part or assembly prohibits the employment of the specified finish, the part or assembly should be given as high a degree of protection as is consistent with its proper functioning for its intended use.

2. CLEANING.

a. CLEANING ALUMINUM-ALLOY PARTS PRIOR TO FINISHING.

(1) All 24ST alclad should receive a phosphoric acid wash prior to the application of a primer.

(2) All aluminum-alloy parts (excluding alclad) that are not to be anodized should have a chromic acid dip prior to the application of the primer.

(3) Surfaces should be clean and dry before applying any finish to them. After cleaning, do not touch the parts with dirty or greasy hands and apply the finish as soon after cleaning and drying as possible.

b. CLEANING OF WELDED ALUMINUM-ALLOY PARTS.

(1) Scrub welded area with a bristle brush under running water and inspect for flaws.

(2) Allow parts to drain.

(3) Immerse in aluminum cleaner, AAF Specification No. 14128 (Navy Aero C-109) or formula "T," at 93° to 100°C (200° to 212°F) for approximately 5 minutes, then remove and rinse in hot water. Aluminum cleaner, formula "T," is made up of the following:

Sodium phosphate dibasic	20 lbs
Sodium metasilicate	10 lbs
Soft soap	8 lbs
Potassium dichromate	2 lbs
Water	100 gals

c. CLEANING WELDED ALUMINUM-ALLOY TANKS.

(1) Wash thoroughly with tap water and a bristle brush, then dry.

(2) Immerse for 20 to 30 minutes in sulphuric acid pickle solution. This solution is made by mixing sulphuric acid and tap water, using 10 gallons of sulphuric acid to every 100 gallons of finished solution.

(3) Rinse inside and out with running tap water for one hour, then drain.

(4) Blow dry with hot air having a temperature of 82°C (180°F).

d. CLEANING UNPLATED STEEL PARTS.—Loose scales on unplated steel parts should be removed by using a steel brush and a satisfactory cleaning agent before applying the protective finish.

e. CLEANING COPPER PARTS.

(1) Copper parts that have been brazed or soldered should be cleaned as follows:

(a) Immerse the parts in a hot electrolytic cleaner tank which contains a solution of plater's cleaner, formula "P," AAF Specification No. 14126. If this material is not available, the following formulation may be used:

Soda ash	10 lbs
Trisodium phosphate	25 lbs
Caustic soda	3.5 lbs
Water	100 gals

(b) Rinse in hot water and dry immediately by either putting in a furnace at a temperature of 104° to 121°C (220° and 250°F), or by blowing dry with compressed air.

(2) After the flux has been removed, oxide and tarnish are removed by either of the following methods:

(a) BRIGHT-DIP CLEANING.

1. Mix 25 gallons of sulphuric acid, 25 gallons of nitric acid, and 20 liquid ounces of hydrochloric acid, and tap water. This mixture makes 100 gallons of final solution. As the acid is being slowly added to the water, stir constantly.

2. Dip parts in and out of this solution until clean and wash with tap water.

3. Rinse with hot water and dry, using compressed air.

(b) SULPHURIC ACID CLEANING.

1. Immerse the parts in a 10 percent sulphuric acid solution for 20 to 30 minutes. Follow with a hot water rinse and dry immediately by putting in a 93° to 121°C (200° to 250°F) oven or by using compressed air.

f. CLEANING WOOD SURFACES.—Exposed wood surfaces should be thoroughly clean and dry before finishing. If a veneered plywood surface is sanded, do not remove more than 5 percent of the face.

g. CLEANING MAGNESIUM ALLOY.—Refer to paragraph 3.*d.*, this section.

(1) MILD ALKALINE CLEANING IMMERSION METHOD.—This cleaning procedure is described in paragraph 2.*b.*(3), this section.

(2) ELECTRO-CLEANING METHOD.

(a) Immerse parts as cathodes in plater's cleaner, formula "P" (refer to paragraph 2.*e.*(1), this section).

(b) Rinse thoroughly with tap water.

h. CLEANING TRANSPARENT PLASTIC ENCLOSURES.

(1) EXTERIOR SURFACES.

(a) Flush with plenty of water, using the bare hand gently to feel and dislodge any dirt, salt, or mud.

(b) Wash with soap and water. Be sure the water is free of dirt or other possible abrasives. A soft cloth, sponge, or chamois may be used in washing, but only as a means of carrying soapy water to the plastic. Go over the surface with only the bare hand so that any dirt can be quickly detected and removed before it scratches the plastic surface.

(c) Dry, preferably with a clean damp chamois. However, a soft clean cloth or soft tissues may be used if care is taken not to continue rubbing the acrylic plastic after it is dry.

(d) Remove oil and grease by rubbing lightly with a cloth wet with kerosene or solvent, Federal Specification No. P-S-661.

CAUTION

> Do not use the following materials on acrylic plastics: acetone, benzene, carbon tetrachloride, anti-icer fluid, fire extinguisher fluids, gasoline, lacquer thinners, or window cleaning sprays because they will soften and cause crazing.

(e) Do not rub the acrylic plastic with a dry cloth since this is not only likely to cause scratches, but it also builds up an electrostatic charge which attracts dust particles to the surface. If the surface does become charged, patting or gently blotting with a clean damp chamois will remove this charge as well as the dust.

(f) If after removing dirt and grease, no great amount of scratching is visible, the plastic should be waxed with a good grade of commercial wax. These waxes will fill in minor scratches and help prevent further scratching. The wax should be applied in a thin even coat and brought to a high polish by rubbing lightly with a soft dry cloth.

(g) If, after removing dirt and grease, the plastic surface is found marred by scratches, apply suitable polish by hand; or if buffing equipment is available, buff out the scratches. Then apply a coat of wax to the polished surface.

CAUTION

> Do not attempt either hand polishing or buffing until the surface is clean. If dirt, grit, and sand are present during these operations they may cause more serious damage than the original scratches. (Since even skillful sanding, buffing, and polishing introduce slight optical distortions, these operations should not be performed on navigator's astrodome. These should be washed and waxed only. If they are damaged by a number of deep scratches, they should be replaced.)

(2) INTERIOR SURFACES.

(a) Dust the plastic surface lightly with a soft clean cloth. Do not *wipe* the surface with a dry cloth.

(b) Wipe carefully with a soft damp cloth or sponge. Keep the cloth or sponge free of grit by rinsing it frequently in clean water.

3. PROTECTIVE FINISHES.

a. PAINT AND DOPE.

(1) PRIMER COATING. — The primer coating, **Specification No. MIL-P-6889a, is used on all parts** requiring a primer. 24ST alclad sheet should receive a primer coating on both surfaces when unpacked. Dural parts, such as castings, forgings, and extrusions, should receive a primer coating immediately after cleaning or after being anodized.

(2) ACIDPROOF LACQUER. — Except for the steel telescoping battery support rods and the moving parts of the release mechanism, all surfaces of the battery shield, battery supports, and the fuselage structure interior surfaces within 3 inches of the battery, should be sprayed with two coats of acidproof lacquer **(Specification No. MIL-T-6095a). This paint is applied over the specified primer coat. The above applies also to all interior surfaces within 6 inches of the toilet.**

(3) FLAT BLACK LACQUER.—The instrument panel should be sprayed with two coats of flat black **lacquer, Specification No. MIL-7178. This is applied over the primer coat.**

(4) CAMOUFLAGE ENAMEL (if used). — Airplanes that were camouflaged were painted in accordance with Douglas Drawing 5115230. The propellers are sprayed with black camouflage enamel. The tip is coated with yellow enamel 4 inches in from the tip.

Camouflage enamels are covered by AAF Specification No. 14109.

(5) DOPE.

(a) CELLULOSE ACETATE BUTYRATE DOPE.—Cloth-covered insulation on the heating system parts and on the water storage tank should be finished with two brush coats of cellulose acetate butyrate dope (Specification No. AN-D-1)

(b) DOPE FOR FABRIC COVERED SURFACES.—Fabric-covered control surfaces should be given two brush coats, followed by two spray coats of clear cellulose nitrate dope (Specification No. AN-TT-D-514). Apply two spray coats of camouflage nitrate dope (AAF Specification No. 14106). The last of these two coats should be thinned sufficiently to flow out the undercoats. Do not thin more than one part thinner to one part package dope. Doped surfaces should not be sanded, but if the nap is raised by the doping operation, the first coat of the pigmented camouflage dope should be lightly scuffed with fine sandpaper.

(6) OMISSION OF PAINT.—No paint should be applied to working surfaces, screw threads. oil holes, etc. Rubber and synthetic rubber parts should remain free of oil, grease, or paint. Paint should not be applied to fittings in such a way as to cause bearings to seize. All electrical parts should be free of paint except the junction boxes in the fire wall.

(7) CLEAR LACQUER.—The area adjacent to the relief tube outlet will be protected with one coat of **clear lacquer, Specification No. MIL-L-7178. This area is conical shaped, 9 inches wide at relief tube outlet, extending aft from the outlet for approximately 5 feet and increasing in width to 18 inches.**

b. ANODIC TREATMENT.—The following items are those which may be given either the chromic acid or sulphuric acid treatment:

(1) Aluminum or aluminum-alloy parts having male tapered threads.

(2) All rivets of heat-treatable alloys such as 17S, A17S and 24S.

(3) Fuel tank castings that are installed with bolts.

(4) Aluminum-alloy rollers and pulleys.

(5) Aluminum-alloy bolts, screws, nuts, nut plates, nut plate strips, and spacers.

(6) Tanks.—See paragraph 3.*g.*, this section.

c. CADMIUM OR ZINC PLATING.—The surface of all steel parts, with the noted exceptions, should be cadmium plated, in accordance with Specification No. AN-P-61 or zinc plated in accordance with Specification No. AN-P-32.

(1) Do not zinc plate parts that are to come in contact with stainless steel and subjected to heat above 260°C (500°F).

(2) Steel screws, bolts, nuts, washers shall be cadmium plated only.

(3) Tinnerman products except washers may be zinc plated.

(4) Cadmium-plated springs should be treated for embrittlement relief by baking for 3 hours at 177° to 240°C (350° to 400°F) immediately after plating.

(5) Brass, bronze, or copper parts are to be plated only for dissimilar metal protection. Threads on pipe fittings need not be plated.

d. TREATMENT FOR MAGNESIUM PARTS.

(1) Magnesium parts should not be cleaned in carbon remover solutions due to corrosion occurring when magnesium comes in contact with chlorinated hydrocarbons. Carbon tetrachloride is also unsatisfactory. Dry cleaning solvent, Federal Specification No. P-S-661, kerosene, or heavy-duty cleaner (paragraph 2.*e.*(2), this section) will be used for this purpose. Those few parts where aluminum and magnesium are integrally incorporated in the part will not be cleaned with formula "H," but will be cleaned by immersion in regular carbon remover, and rinsed with dry cleaning solvent, Federal Specification No. P-S-661.

(2) If corrosion is evident after the grease and oil are removed, this may be removed with a chromic acid bath consisting of 1.5 pounds chromic acid with water added to make 1 gallon. The parts may be immersed in this solution at any temperature from room temperature to 93°C (200°F), from 1 to 15 minutes, as required. Copper or copper-alloy fittings should be removed or protected before this process.

(3) After drying, the freshly chrome pickled part should be immersed for 10 minutes in a solution containing 15 to 20 percent by weight of hydrofluoric acid at room temperature and washed thoroughly in cold running water. It should then be boiled for a least 45 minutes in a water solution containing 10 to 15 percent by weight of sodium dichromate. If assemblies containing aluminum parts are being processed, a 5 percent sodium acid fluoride (Na HF_2) solution should be substituted for the hydrofluoric acid.

CAUTION

Hydrofluoric acid in poisonous and produces severe skin burns which are slow to heal. Use with extreme care!

e. FINISHING ALUMINUM-ALLOY TUBING.—The interior surface of open-end aluminum-alloy **structural tubing will receive one coat of primer, Specification No. MIL-P-6889a. No finish should be** applied to the interior surfaces of nonstructural tubing, such as conduits, lines, etc. Closed end structural aluminum or aluminum-alloy tubing requires no interior finish.

f. FINISHING STEEL TUBING.—The interior surface of open steel tubing should receive one coat of primer. Steel tubing completely sealed by welding, brazing, etc., requires no internal treatment except for those to be heat treated. In such case the tubing has vent holes drilled into it and is treated by forcing heated corrosion-preventive compound, Specification **No. MIL-C-6708, or raw linseed oil, Federal Specification No. TT-O-369, into the holes and allowing it to remain for 2 minutes. Drain all excess compound from the parts and seal the holes with a drivescrew dipped in zinc chromate primer.**

g. FINISHING OF TANKS.

(1) Clean welded tanks as specified in paragraph 2.*c.*, this section.

(2) Alcohol tanks should receive the Alrok or anodic treatment.

(3) Engine oil tanks should be flushed with SAE 20 oil.

(4) Wash basin water tanks should receive one coat of Sherwin-Williams water tank coating compound No. 240.

(5) Drinking water tank should be slushed with Sherwin-Williams tank coating compound No. 240.

(6) All tanks should have the exterior surface sprayed with primer.

h. FINISHING OF EXTERNAL SURFACES.—The external surface of some of the airplanes was camouflaged in accordance with Douglas Drawing 5115230. The paints and dopes used are covered under paragraph 3.*a.*, this section.

i. FINISHING OF INTERNAL PARTS AND SURFACES.

(1) ALUMINUM AND ALUMINUM-ALLOY PARTS AND SURFACES.—Unless otherwise specified in the following paragraphs, no finish in addition to the initial primer should be applied to the interior aluminum and aluminum-alloy parts and surfaces of the airplane.

(2) INTERIOR WOOD PARTS AND SURFACES.—Wood parts and surfaces should be thoroughly cleaned and dried prior to finishing. Should sanding be required on veneered plywood surfaces, do not sand off more than 5 percent of the face surface.

(a) INTERIOR ENCLOSED WOOD SURFACES.—Interior enclosed wood surfaces will require only two coats of varnish, Specification No. AN-TT-V-118, as a finish.

(b) INTERIOR OPEN WOOD SURFACES.—Interior open wood surfaces should be finished with two brush or dip coats of varnish, Specification No. AN-TT-V-118, and two coats of bronze-green lacquer, Specification No. AN-L-29. For the finish of the radio operator's table, see paragraph *j.*(2), following.

j. FINISHING OF MISCELLANEOUS PARTS.

(1) Cable terminals made from a noncorrosive-resistant steel should be zinc plated after heat treatment, prior to swaging. After swaging, paint with two coats of zinc chromate primer, Specification No. AN-TT-P-656.

(2) The writing surface of the radio operator's table should receive two coats of varnish, Specification No. AN-TT-V-118, one coat of wood surfacer, AAF Specification No. 14115, and two coats of bronze-green lacquer, Specification No. AN-L-29. All other surfaces of this table should be finished as specified in paragraph 3.*i.*(2)*(b)*, preceding.

(3) The propeller pitch control pulley, Douglas part No. 2118653, and the propeller pitch control

plate, Douglas part No. 1118629, should receive only the anodic treatment as a finish.

(4) TREATMENT OF CABLES.—Immerse the cable assembly in corrosion preventive compound, Specification No. MIL-C-6708 at approximately 22°C (72°F) for a minimum of 30 seconds in such a way as to hold fittings containing lubricated bearings out of fluid. Remove cable assembly and allow to drain until suitable for handling. Wrap in wax paper and mark with part number.

4. THREAD LUBRICANTS.

a. ANTISEIZE COMPOUND, SPECIFICATION NO. JAN-A-669.—This thread lubricant is to be used on all aluminum-alloy, brass, and steel line fittings (with the exception of those used with the oxygen system lines).

b. LUBRICANT, SPECIFICATION NO. MIL-C-5542.—This thread lubricant will be used on all oxygen lines fittings regardless of material.

5. LINE IDENTIFICATION.

Lines, ducts, and power plant disconnect points are identified as follows:

Type of Line	*Color Banding*	*Application*
Heating System,		
—Cold Air	Yellow Red Yellow	Cold air intake to outlet
—Hot Air	Light Blue Red	Hot Air, heating point to outlet
Air Pressure		
—De-icer	Light Blue Light Green	Air to de-icer shoes
—Air brakes	Yellow Light Green	Air to Air Brakes
Fire Extinguisher	Brown	Storage bottle to outlets
Anti-Icer		
—Alcohol	White Yellow	Storage tank to outlets
Fuel	Red	All lines in fuel system
Manifold Pressure	White Light Blue	Manifold to pressure gage
Hydraulic	Light Blue Yellow Light Blue	All hydraulic system lines
Oil	Yellow	All oil system lines
Oxygen		
—Dispensing	Light Green	Cylinders to outlets
—Refilling	Light Green Yellow Light Green	Filler valve to cylinders
Pitot	Black	Pitot tube to instrument panel
Static	Black Light Green	Static tube to instrument panel
Steam	Light Blue Black	Heating system steam lines
Vacuum	White Light Green	Vacuum pump to instrument panel, etc.
Water —Drinking	White Light Blue White	Reservoir to outlets

a. APPLYING COLOR BANDING.—Banding may be lacquer, ½ inch wide, cellulose acetate tape, or equivalent. The banding tape, if used, should extend at least one and one-half turns around the tubing and should be covered with a coating of clear lacquer, Specification No. AN-TT-L-51, reduced 1:1 with thinner, Specification No. MIL-T-6094A. Banding should be applied within approximately 3 inches of the line joints and at intervals necessary to make possible tracing the line to its termination. Points of line disconnection for power plant removal are to be colored either with tape or lacquer of international orange.

6. IDENTIFICATION OF CONTROL KNOBS.

Knob	*Color*	*Catlin Color No.*
Air Controls (Hot or Cold)	Blue	1563
Vacuum Instruments Shut-Off and Selector Valves	Blue	1563
Oil Cooler Controls	Yellow	1533
Automatic Pilot Controls	Yellow	1533
Oxygen Controls	Green	1536
De-icer Controls	Green	1536
Fuel Valve Controls	Red	1501
Fire Extinguisher Controls	Red	1501
Landing-Gear	Red	1501
Landing-Gear Emergency Release	Red	1501
Hydraulic Hand Pump	Red	1501
Propeller RPM Lock	Red	1501
Surface Control Lock	Red	1501
Throttle Lock	Red	1501
Emergency Brake Control	Red	1501
Glider Tow Release	Red	1501
Engine Throttle	Black	560
Cowl Flaps Control	Purple	575
Propeller RPM Control	White	201
Electrical Switches	Optional	(black preferred)
Wing Flap Controls	Optional	(black preferred)
Parking Brake Lever	Optional	(black preferred)
Tab Controls	Optional	(black preferred)
Hydraulic Controls	Optional	(black preferred)
Radio Controls	Optional	(black preferred)

7. ELECTRICAL BONDING.

The airplane should be electrically bonded in accordance with Douglas Drawing 5202128.

8. SPOT WELDING.

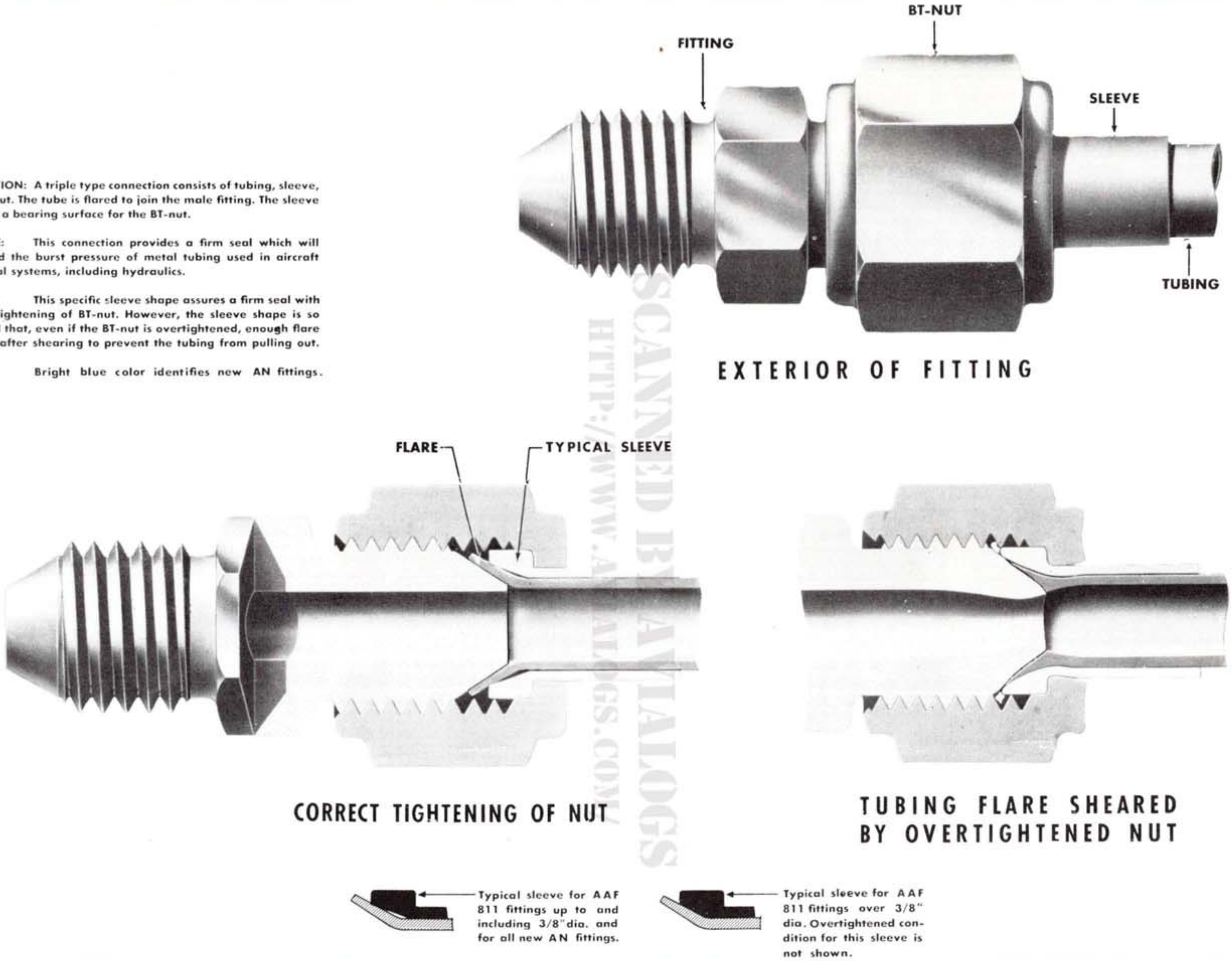
All spot welding should be in accordance with AAF Specification No. 20011 (Navy Aero. PW-6).

DESCRIPTION: A triple type connection consists of tubing, sleeve, and BT-nut. The tube is flared to join the male fitting. The sleeve provides a bearing surface for the BT-nut.

PURPOSE: This connection provides a firm seal which will withstand the burst pressure of metal tubing used in aircraft functional systems, including hydraulics.

This specific sleeve shape assures a firm seal with normal tightening of BT-nut. However, the sleeve shape is so designed that, even if the BT-nut is overtightened, enough flare remains after shearing to prevent the tubing from pulling out.

Bright blue color identifies new AN fittings.



EXTERIOR OF FITTING

CORRECT TIGHTENING OF NUT

TUBING FLARE SHEARED BY OVERTIGHTENED NUT

Typical sleeve for AAF 811 fittings up to and including 3/8" dia. and for all new AN fittings.

Typical sleeve for AAF 811 fittings over 3/8" dia. Overtightened condition for this sleeve is not shown.

Figure 620—Triple Type Tubing Sleeve

A. COLOR BANDING CHART

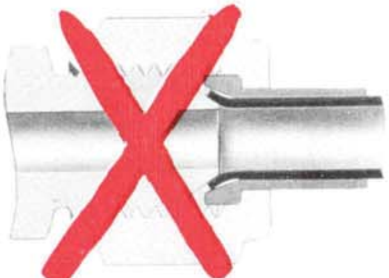
TYPE OF LINES: (For complete reference refer to D.P.S. #3.22) COLORS:

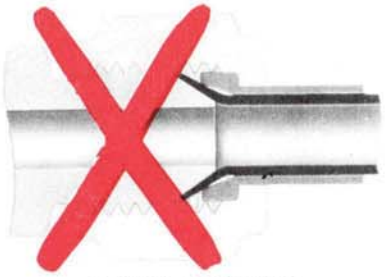
TYPE OF LINES	COLORS
AIR - LOW PRESSURE (MAX. 20 P.S.I.)	BLUE & GREEN
AIR - HIGH PRESSURE (MIN. 25 P.S.I.)	GREEN & YELLOW
ANTI-ICER (ALCOHOLIC)	WHITE & RED
AUTOMATIC GYRO-PILOT	BLUE & YELLOW & BLUE
COOLANT (PRESTONE)	WHITE & BLACK & WHITE
COOLANT (WATER)	WHITE
EXHAUST ANALIZER	BLUE & BROWN
FIRE EXTINGUISHER	BROWN
FLOTATION GEAR	BLUE
GASOLINE	RED
HYDRAULIC	BLUE & YELLOW & BLUE
MANIFOLD PRESSURE	WHITE & BLUE
OIL - LUBRICATING	YELLOW
OXYGEN	GREEN
OXYGEN FILLER	GREEN & YELLOW & GREEN
PURGING	BLUE & YELLOW
PITOT PRESSURE	BLACK
STATIC PRESSURE	BLACK & GREEN
STEAM	BLUE & BLACK
VACUUM	WHITE & GREEN
VENT - CLOSED COMPARTMENTS	RED & BLACK

B. CORRECT BT-NUT TORQUE LOADS IN INCH-POUNDS

for tightening of AAF 811 or new AN fittings for the tubing materials indicated:

TORQUE IN INCH-POUNDS COPPER TUBING & DURAL #52 SO TUBING			TUBING'S OUTSIDE DIAMETER	WRENCH SIZE	TORQUE IN INCH-POUNDS STAINLESS STEEL TUBING #18-8 GR15-¼H		
MINIMUM	RECOMMENDED	MAXIMUM			MINIMUM	RECOMMENDED	MAXIMUM
9.4	12.5	15.6	1/8	3/8			
21.1	28.2	35.2	3/16	7/16	60.	80.	100.
37.5	50.0	62.5	1/4	9/16	100.	125.	150.
58.6	78.0	97.7	5/16	5/8	150.	175.	200.
84.0	112.0	140.6	3/8	11/16	200.	225.	250.
115.0	153.0	192.0	7/16	3/4			
150.0	200.0	250.0	1/2	7/8	325.	362.5	400.
191.0	253.0	316.0	9/16	15/16			
235.0	312.0	319.0	5/8	1	475.	525.	575.
337.0	450.0	562.0	3/4	1- 3/16	650.	712.5	775.
394.0	525.0	655.0	7/8	1- 3/8			
450.0	600.0	750.0	1	1- 1/2	For correct tightening use a torque wrench.		
505.0	675.0	860.0	1-1/8	1-11/16			
562.0	750.0	940.0	1-1/4	1-15/16			
675.0	900.0	1120.0	1-1/2	2- 1/4			
788.0	1050.0	1310.0	1-3/4	2- 5/8			
900.0	1200.0	1500.0	2	2- 5/16			


TUBING FLARED TOO SHORT


TUBING FLARED TOO LONG

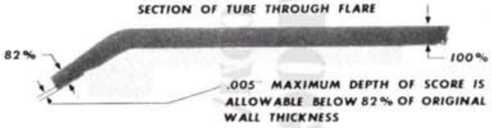
C. FLARING

During the flaring process, tubing is stretched thinner in flare area. But to be acceptable for use, at least 82% of the original wall thickness must remain in the flare.

SCORING AND REJECTION

When installing lines, the outside of the tubing flare must not be marked to a depth greater than .005 of an inch below a straight line extending from base of flare on the exterior side of flare (as shown by diagram).

SECTION OF TUBE THROUGH FLARE


82%
100%
.005" MAXIMUM DEPTH OF SCORE IS ALLOWABLE BELOW 82% OF ORIGINAL WALL THICKNESS

When reinstalling any lines, under no circumstances should a line be used unless the flare retains at least 50% of its original wall thickness. The tubing flare must extend beyond the sleeve between 1/32" and 1/16".Note:1/8 dural tubing requires a flare from flush with end of sleeve to a maximum extension of 1/32".

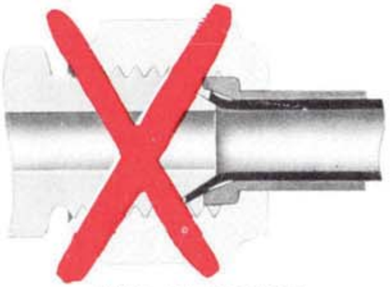
D. LUBRICATION NOTE

(Triple Type Tubing Connections)

Approved thread lubricant to be used with the lines and fittings of different systems will be found by reference to D.P.S. #1.22 (Douglas Process Standards).

Apply lubricant sparingly on outside of sleeve and on male threads of fitting. Clean the excess lubricant from fitting to prevent its entering into the lines.

Lubricant is used in order that the BT-nut will turn easily to prevent its binding with the sleeve. Binding of BT-nut and sleeve would cause the sleeve to turn on the tubing resulting in the scoring or shearing of the flare.


TUBING NOT CUT SQUARE

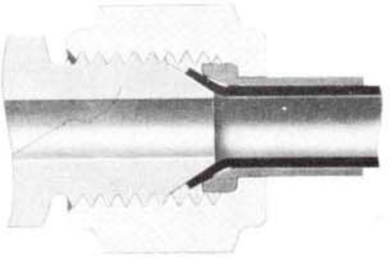

TUBING FLARED CORRECTLY

Figure 621—Triple Type Tubing Sleeve Information

SECTION VIII
TUBING CHARTS

1. GENERAL.

This section contains illustrations and keys to these illustrations for each system of tubing in the airplane. The keys give replacement information and part numbers for lines, hose, and connecting fittings. Illustrations in this section are as follows, in the order of their placement:

Figure 620—Triple-Type Tubing Sleeve
Figure 621—Triple-Type Sleeve Tubing Information
Figure 622—Manifold Pressure Instrument System (Lines and Fittings)
Figure 623—Original C-47A Oil System (Lines)
Figure 624—Original C-47A Oil System (Fittings)
Figure 625—Original C-47 Oil System (Lines and Fittings)
Figure 626—C-47A Oil System (With Pressure Transmitter and Fire Wall Surge Valve) (Lines and Fittings)
Figure 627—C-47A Oil System (With D-8 Surge Valve and Cooler) (Lines and Fittings)
Figure 628—Fuel System (Lines)
Figure 629—Fuel System (Fittings)
Figure 630—Vacuum System for Instruments and Automatic Pilot (Lines and Fittings)
Figure 631—Pitot-Static Instrument System (Lines and Fittings)
Figure 632—Remote Oil-Pressure Indicating System (Lines and Fittings)
Figure 633—Automatic Pilot System (Lines and Fittings)
Figure 634—Hydraulic Supply, Pressure, and Return System (Lines and Fittings)
Figure 635—Detail of Hydraulic Control Panel Supply, Pressure, and Return System (Lines and Fittings)
Figure 636—Cowl Flap Hydraulic System (Lines and Fittings)
Figure 637—Wing Flap Hydraulic System (Lines and Fittings)
Figure 638—Windshield Wiper and Nonram Air Scoop Hydraulic Systems (Lines and Fittings)
Figure 639—Landing-Gear Hydraulic System (Lines and Fittings)
Figure 640—Brake Hydraulic System (Lines and Fittings)
Figure 641—Engine Fire Extinguisher System (Lines and Fittings)
Figure 642—Steam Heating and Ventilating System (Lines and Fittings)
Figure 643—Surface De-Icer System (Lines)
Figure 644—Surface De-Icer System (Fittings)
Figure 645—Detail of Surface De-Icer Distributor Valve (Lines and Fittings)
Figure 646—Carburetor Anti-Icer System (Lines and Fittings)
Figure 647—Propeller Anti-Icer System (Lines and Fittings)
Figure 648—Windshield Anti-Icer System (Lines and Fittings)
Figure 649—High-Pressure Oxygen System (Lines and Fittings)
Figure 650—Low-Pressure Oxygen System (Lines)
Figure 651—Low-Pressure Oxygen System (Fittings)

KEY TO FIGURE 622

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
1	5112318-6	1	1/4 OD x .035 52 SO	50	AF811BT-4D AF811T-4CS	2 2	Instrument panel connect plate to forward fuselage connect plate LH
2	5112318-8	1	1/4 OD x .035 52 SO	49	AF811BT-4D AF811T-4CS	2 2	Instrument panel connect plate to forward fuselage connect plate RH
3	5112318-7	1	1/4 OD x .035 52 SO	146-3/4	AF811BT-4D AF811T-4CS	2 2	Forward fuselage connect plate to aft fuselage connect plate RH
4	5112313-24	1	1/4 OD x .035 52 SO	10-1/2			Blower case to hose RH

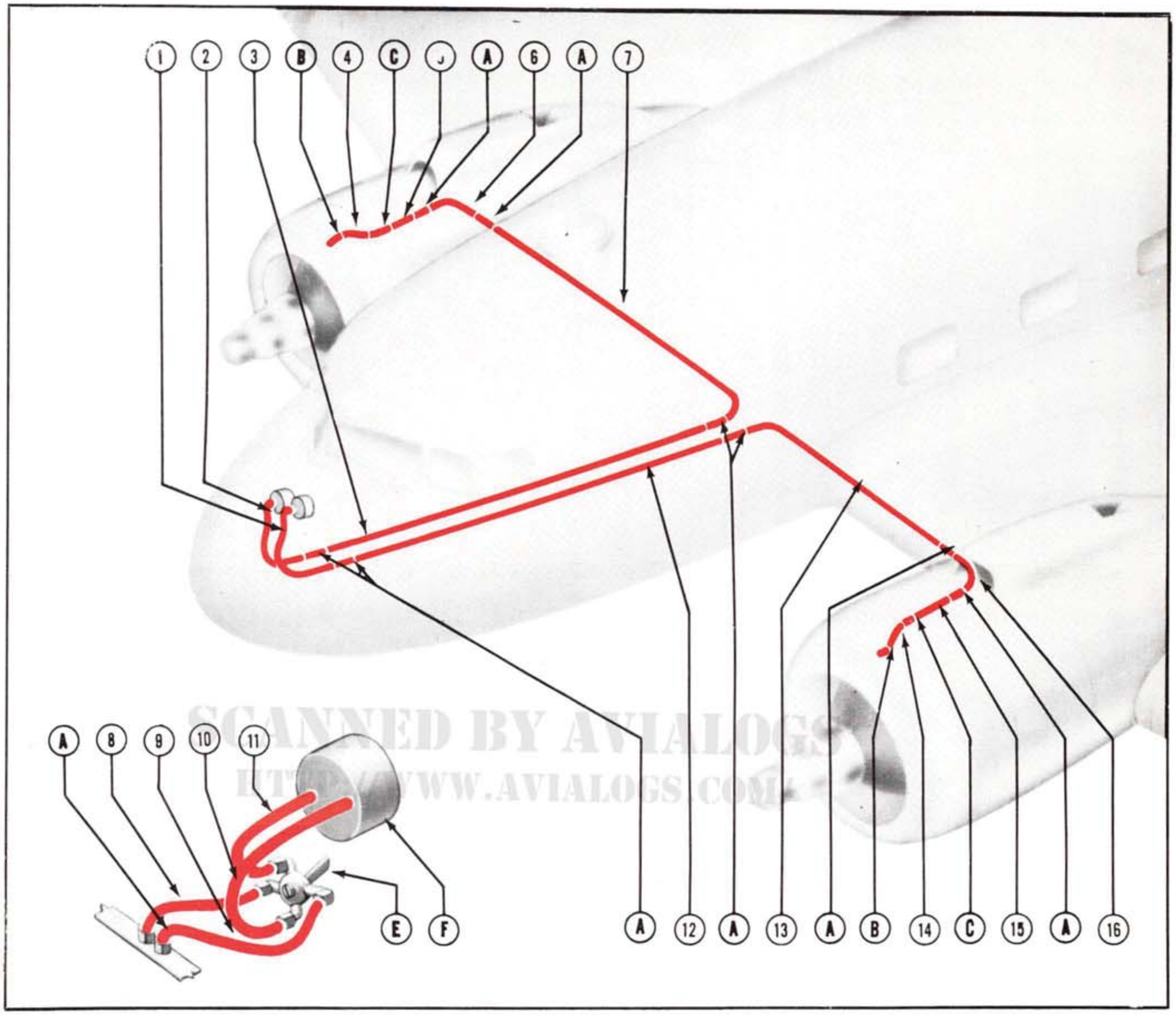


Figure 622—Manifold Pressure Instrument System (Lines and Fittings)

KEY TO FIGURE 622—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
5	5112313-33	1	1/4 OD x .035 52 SO	20-1/4			Hose to fire wall LH
6	5112315-49	1	1/4 OD x .035 52 SO	35-1/2	AF811BT-4D AF811T-4CS	2 2	Fire wall to nacelle connect plate RH
7	5112315-50	1	1/4 OD x .035 52 SO	64-1/2	AF811BT-4D AF811T-4CS	2 2	Nacelle connect plate to aft fuselage connect plate RH
8	5116836-14	1	1/4 ID Weatherhead flex hose	15-5/8	014D Weatherhead		Selector Valve to Manifold Assembly
9	5116836-13	1	1/4 ID Weatherhead flex hose	15-5/8	014D Weatherhead		Selector Valve to Manifold Assembly
10	5116836-33	1	1/4 ID Weatherhead flex hose	12	014D Weatherhead		Manifold press. gage to Selector Valve
11	5116836-32	1	1/4 ID Weatherhead flex hose	12	014D Weatherhead		Manifold press. gage to Selector Valve

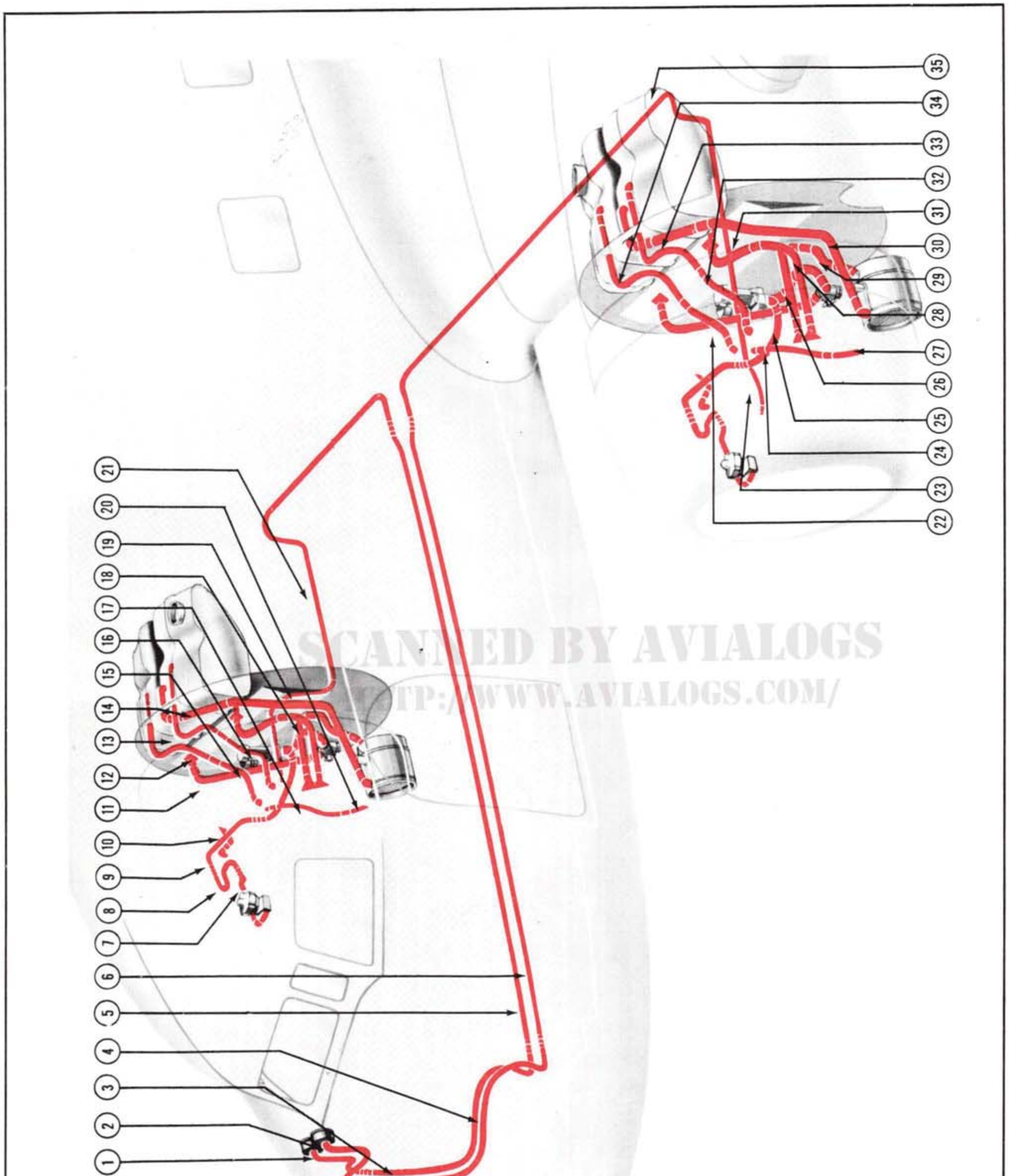

①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
⑫
⑬
⑭
⑮
⑯
⑰
⑱
⑲
⑳
㉑
㉒
㉓
㉔
㉕
㉖
㉗
㉘
㉙
㉚
㉛
㉜
㉝
㉞
㉟

Figure 623—Original C-47A Oil System (Lines)

KEY TO FIGURE 622—Continued

Item	Part No.	No. Req	Size and Material	Lgth	Fittings	Ftgs Per Line	Description
12	5112318-5	1	1/4 OD x .035 52 SO	146-3/8	AF811BT-4D AF811T-4CS	2 2	Forward fuselage connect plate to aft fuselage connect plate LH
13	5112315-48	1	1/4 OD x .035 52 SO	116-3/4	AF811BT-4D AF811T-4CS	2 2	Nacelle connect plate to aft fuselage connect plate LH
14	5112315-47	1	1/4 OD x .035 52 SO	35	AF811BT-4D AF811T-4CS	2 2	Fire wall to nacelle connect plate LH
15	5112313-34	1	1/4 OD x .035 52 SO	20-1/4			Hose to fire wall RH
16	5112313-23	1	1/4 OD x .035 52 SO	12-1/4			Blower case to hose LH

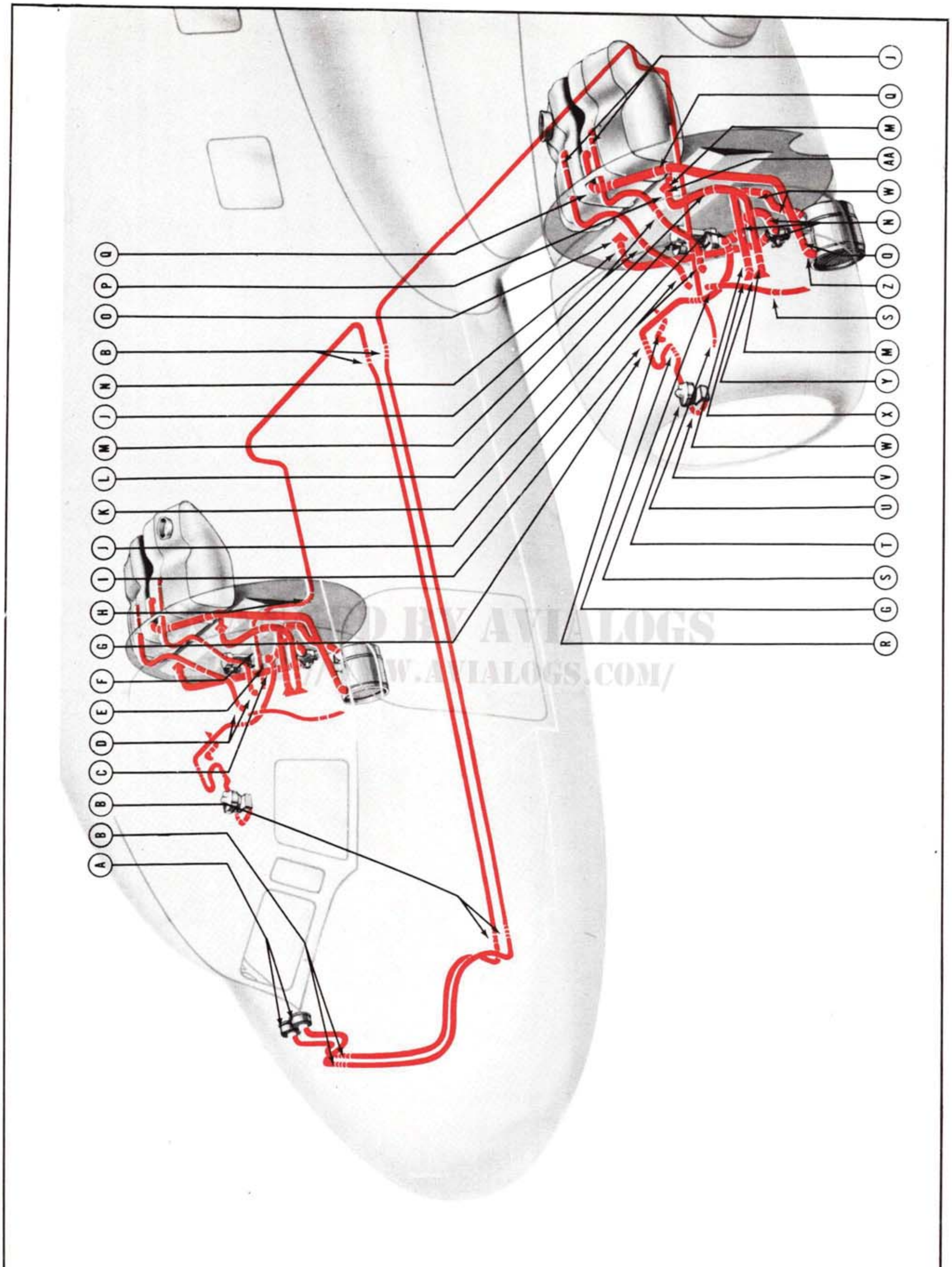
Item	Part No.	Part Name
A	3115-1HT-4D	Parker Coupling
	11-1039-1-3D	Parker Lock Nut
B	3706H-4-9	Hose
	S148779-851-4-55	Hose Elbow
	AC895-80	Reducer
C	3706H-4-9	Hose
E	1019166	Manifold Pressure Valve
F	See Instrument Chart, paragraph 11.*h.*, section IV	Manifold Pressure Gage

KEY TO FIGURE 623

Item	Part No.	No. Req	Size and Material	Lgth	Fittings	Ftgs Per Line	Description
1	5116836-18	1	1/4 ID Weatherhead flex hose	17-5/8	014D	1	RH oil-pressure gage to brkt assembly
2	5116836-17	1	1/4 ID Weatherhead flex hose	20-3/4	014D	1	LH oil-pressure gage to brkt assembly
3	5112305-11	1	1/4 OD x .035 alum. alloy	48-1/4	AF811-BT4D Nut AF811-T4CS Sleeve	2 2	RH oil-pressure line brkt assembly to conn plate assembly
4	5112305-10	1	1/4 OD x .035 alum. alloy	49-3/4	AF811-BT4D Nut AF811-T4CS Sleeve	2 2	LH oil-pressure line brkt assembly to conn plate assembly
5	5112305-13	1	1/4 OD x .035 alum. alloy	147-1/2	AF811-BT4D Nut AF811-T4CS Sleeve	2 2	RH oil-pressure line conn plate assembly to conn plate assembly
6	5112305-12	1	1/4 OD x .035 alum. alloy	147-1/2	AF811-BT4D Nut AF811-T4CS Sleeve	2 2	LH oil-pressure line conn plate assembly to conn plate assembly
7	5112324-9	2	5/8 OD x .049 Everdur bronze tube	20	AF811BT-10 AF811T-10CS	2 2	Governor to union
8	5112324-2	2	5/8 OD x .049 Everdur bronze tube	22	AF811BT-10 AF811T-10CS	2 2	Union to engine section diaphragm
9	5112324-3	2	5/8 OD x .049 Everdur bronze tube	17	AF811BT-10 AF811T-10CS	2 2	Engine section diaphragm to hose

KEY TO FIGURE 623—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs Per Line*	*Description*
10	5112314-19	2	1 OD x .049 52SO alum. alloy	19-1/2			Front case breather
11	5112324-8	2	1 OD x .049 52SO alum. alloy tube	43-1/2			Fire wall to "Y" drain
12	5112314-10	1	1/2 OD x .035 52SO alum. alloy	24-1/2			Vent hose to tank RH
13	5112314-8	1	1/2 OD x .035 52SO alum. alloy	30			Vent Hose to tank LH
14	5112314-22	2	1 OD x .049 52SO alum. alloy	23			Hose to tank
15	5112314-9	1	1/2 OD x .035 52SO alum. alloy	17-1/2			Vent—Engine to hose RH
16	5112314-7	1	1/2 OD x .035 52SO alum. alloy	18-1/2			Vent—Engine to hose LH
17	5112314-17	1	5/8 OD x .042 52SO alum. alloy	21-1/2			Rear case to hose RH
18	2131494	2	5/8 ID Weatherhead flex hose	26-1/2	AN811 Swivel Type Fitting 7/8-18 Int-Thd AF811CT-10	1 1	Hose Assembly—Prop feathering flex
19	5112314-16	1	1/4 OD x .035 52SO alum. alloy	50	AF811BT-40 AF811T-4CS	2 2	Press. line engine to fire wall plate RH
20	5112314-23	1	5/8 OD x .042 52SO alum. alloy	15			Hose to atmosphere RH
21	5112316-5	1	1/8 OD x .028 copper tube	384-1/2	AN818-2D AN819-2D	2 2	Fus conn panel to LH fire wall conn panel
22	5112314-13	1	1/2 OD x .035 52SO alum. alloy	17-1/2			Vent—Engine to hose LH
23	2119836-2	2	1/8 ID Weatherhead flex hose	31			Hose—1/8 ID high press. flex
24	5112314-18	1	5/8 OD x .042 52SO alum. alloy	22			Rear case to hose LH
25	2131494	Ref Item 18	5/8 ID Weatherhead flex hose	26-1/2	AN811 Swivel Type Fitting 7/8-18 Int-Thd AF811CT-10	2 2	Hose Assembly—Prop feathering flex
26	5112314-4	2	1 OD x .049 52SO alum. alloy	19			Engine outlet to hose
27	5112314-24	1	5/8 OD x .042 52SO alum. alloy	17-1/2			Hose to atmosphere
28	2141956	2	1-1/2 OD x .049 52SO alum. alloy tube	16			Tube Assembly—Engine oil dilution
29	5112314-26	2	1 OD x .049 52SO alum. alloy	20-1/4			Hose to cooler
30	5112314-6	2	1 OD x .049 52SO alum. alloy	38-1/2			Cooler to hose
31	5112314-25	2	1-1/2 OD x .049 52SO alum. alloy	13			Tank to hose
32	5112314-11	1	1/2 OD x .035 52SO alum. alloy	19			Vent—Engine to hose LH
33	5112314-12	1	1/2 OD x .035 52SO alum. alloy	27-1/2			Vent—Hose to tank LH
34	5112314-14	1	1/2 OD x .035 52SO alum. alloy	24			Vent—Hose to tank RH
35	5112316-6	1	1/8 OD x .028 copper tube	309-1/2	AN818-2D AN819-2D	2 2	Fus conn panel to RH fire wall conn panel


A
B
B
C
D
E
F
G
H
I
J
K
L
M
N
B
O
P
Q
R
G
S
T
U
V
W
X
Y
M
S
Z
Q
N
W
AA
M
Q
J

DOWNLOADED BY AVIALOGS

Figure 624—Original C-47A Oil System (Fittings)

KEY TO FIGURE 624

Item	*Part No.*	*Fittings*	*No. Required* *LH*	 *RH*
A	AW-1 7/8-14CJ	Oil-Pressure Gage	1	1
	AN5772-2	Oil-Pressure Gage (Dual Gage)	1	Per Apl
B	Parker No. 3115-1HT-4D	Bulkhead Coupling	3	3
	11-1039-13D	Lock Nut	3	3
C	AF851-8	Elbow 45°	2	2
D	AF895-86	Reducer Bushing	1	1
E	AF811CT-10	Elbow	1	1
F	AF811HT-4D	Union		1
G	AF811HT-10	Union	1	1
H	AN833-2D	Elbow		1
	AN924-2D	Lock Nut		1
I	Parker 3115-1HT-10	Bulkhead Coupling	1	1
	Parker 11-1039-1-14	Lock Nut	1	1
J	AN884-8-12	Hose	6	6
K	111776	Elbow	1	1
L	54772-2	Propeller Feathering Pump	1	1
M	AN884-24-14	Hose	3	3
N	3706-16-14	Weatherhead Hose	4	4
O	2118881	Connector	1	1
P	514504-2 (Make from AF884-24-14)	Hose	1	1
Q	AN884-16-14	Hose	3	3
R	AN884-16-12	Hose	1	1
S	AN884-10-12	Hose	2	2
T	Type 4K11	Propeller Governor	1	1
	or			
	Type 4G-8-6-15D	Propeller Governor	1	1
U	148779 Parker 4CT455-55	Restricter Elbow	1	1
V	AF811CT-45-10	Union	1	1
W	AN884-16-18	Hose	3	3
X	Parker No. A9-1940-14-16D or 1142641	Fitting	1	1
Y	Parker No. A9-1040-2-2-240	Fitting	1	1
Z	AF852-16	Elbow (Hose)	1	1
AA	1119903	Plate	1	1
	1119902	Gasket	1	1

KEY TO FIGURE 625

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
1	5112324-1	2	5/8 OD x .049 corr-resist steel tube	21-1/4	AF811BT-10 AF811T-10CS	2 2	Governor to union
2	5112314-15	2	1/4 OD x .035 52SO alum. alloy	8-1/4	AF811-BT-4D AF811T-4CS	2 2	Oil-pressure switch to fire wall disconnect plate
3	5112324-4	2	1 OD x .049 alum. alloy tube	31-1/2			Pump to fire wall
4	5112314-1	2	1-1/2 OD x .049 alum. alloy 52SO	19			Tank to tee
5	5112313-14	2	1/4 OD x .035 52SO alum. alloy	10-1/4	AF811BT-4D AF811T-4CS	2 2	Oil dilution solenoid to drain tee
6	5112314-3	2	1 OD x .049 52SO alum. alloy	6-5/8	AF811BT-16D AF811T-16CS	2 2	Tee to drain cock
7	5112314-26	1	1 OD x .049 52SO	20-1/4			Hose to cooler
8	5112314-2	2	1-1/2 OD x .049 52SO alum. alloy	10-7/8			Tee to engine inlet

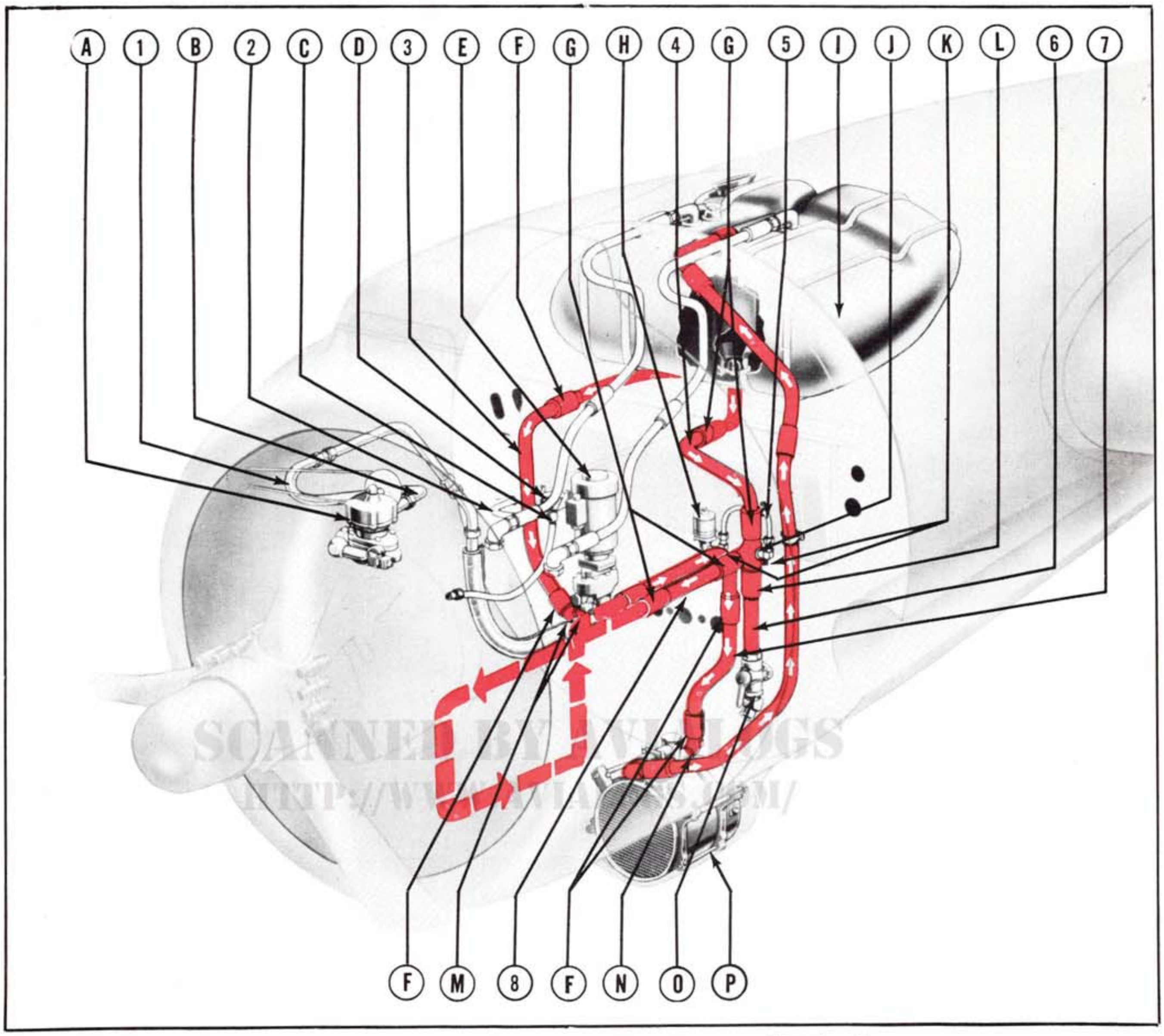


Figure 625—Original C-47 Oil System (Lines and Fittings)

KEY TO FIGURE 625—Continued

Item	*Part No.*	*Part Name*	*No. Req* *LH*	*RH*
A	Hamilton Standard 4K11	Propeller Governor	1	1
B	AF811CT-45-10	Elbow	1	1
C	AF811RT-4	Tee	1	1
D	Pioneer No. 3122-1	Warning Switch	1	1
E	Hamilton Standard 53535	Pump	1	1
F	No. 3706-16-14	Hose	4	4
G	No. 3706-24-14	Hose	4	4
H	AF37D-6210	Oil Dilution Solenoid	1	1
I	5110511	Tank	1	1
J	4117228	Tee	1	1
K	AF811CT-4	Elbow	2	2
L	No. 3706-16-11	Hose	1	1
M	Parker 3151-DN 4215 3/4	45-Degree Street Elbow	1	1
N	AF835-16	Elbow 45-Degree	1	1
O	Parker B7-741-2-1	Plug Valve	1	1
P	1119784	Oil Cooler	1	1

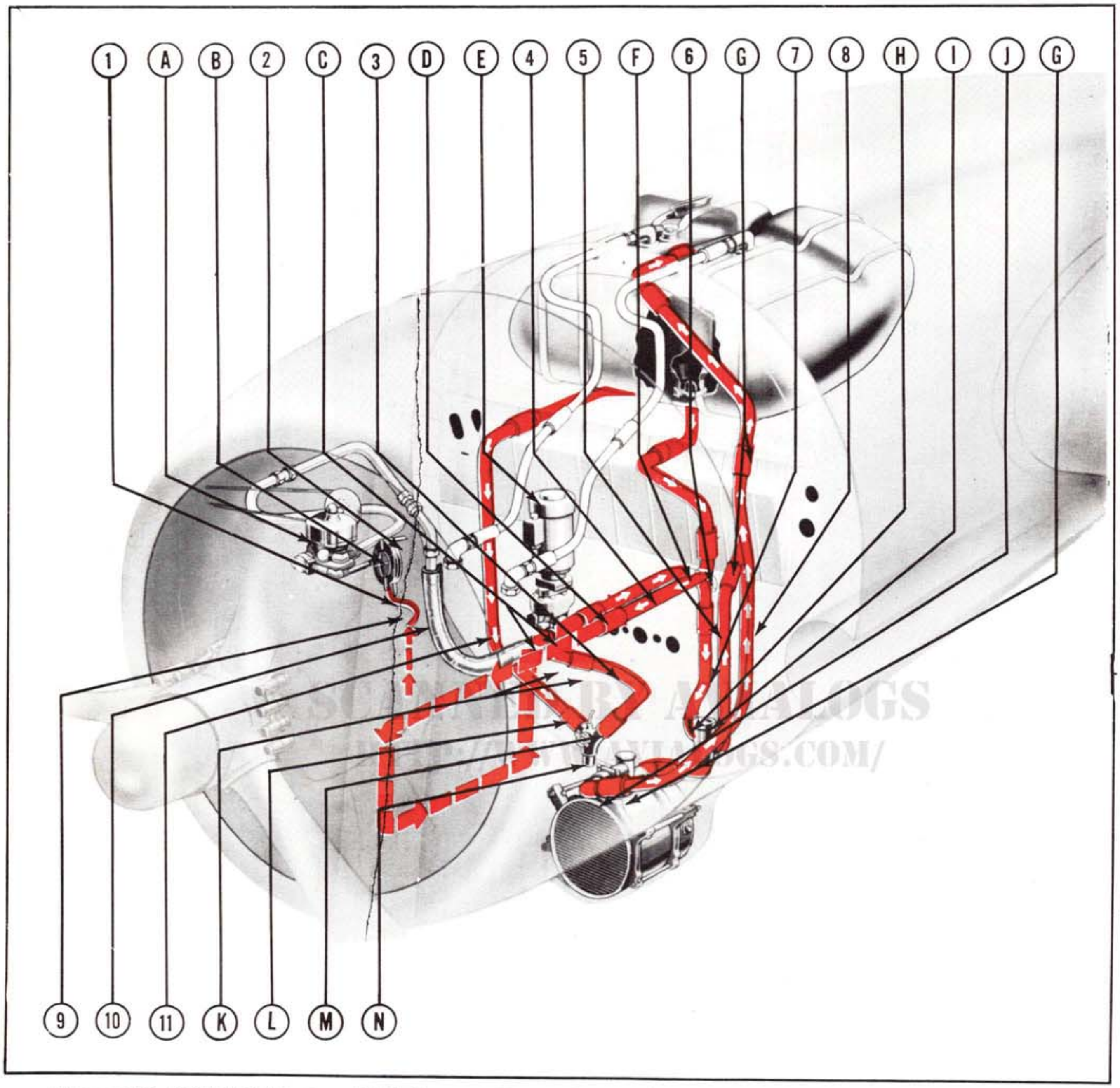


Figure 626—C-47A Oil System (With Pressure Transmitter and Fire Wall Surge Valve) (Lines and Fittings)

KEY TO FIGURE 626

Item	*Part No.*		*Part Name.*	*No. Req* *LH*	*RH*
A	Type 4G-8-G-15D		Hamilton Standard Propeller Governor	1	1
		or			
	Type 4K11-GOJ		Hamilton Standard Propeller Governor	1	1
B	Type A-1		Oil-Pressure Transmitter	1	1
C	AF895-86		Reducing Bushing	1	1
	AF811CT-10		Elbow	1	1
D	AN884-24-14		Hose		
E	54772-2		Hamilton Standard Feathering Pump	1	1
F	AF811CT-4D		Elbow	1	1
		or			
	AN842-4		Elbow	1	1
G	AN884-16-14		Hose	6	6
H	AN842-16		Elbow 90-Degree	1	1

KEY TO FIGURE 626—Continued

Item	Part No.	Part Name	No. Req LH	No. Req RH
I	U-A-4400-1	Surge Valve	1	1
J	AN844-16	Elbow	1	1
K	AN878-20-14	Hose	1	1
L	AN878-20-14	Hose	2	2
M	AN878-16-14	Hose	1	1
N	K1400B-5	Koehler "Y" Drain Valve	1	1

Item	Part No.	No. Req	Size and Material	Lgth	Fittings	Ftgs per Line	Description
1	5112314-38	2	1/4 OD x .035 52SO	11	AF811BT-4D AF811T-4D	2 2	Transmitter to check valve
2	5112314-37	1	1/4 OD x .035 52SO	4-7/8	AF811BT-4D AF811T-4D	2 2	LH transmitter to flexible line
	5112314-33	1	1/4 OD x .035 52SO	34	AF811BT-4D AF811T-4D	2 2	Pressure Line—Engine to fire wall plate
3	2202864 Consists of:	2					Propeller line assembly weld −2 and −4
	2202864-2	1	1 OD x .049 52SO	11-1/4			
	2202864-4	1	1-1/4 OD x .049 52SO	3-1/2			
4	2203870	2	1-1/2 OD x .049 52SO	15-1/2			Line assembly—Oil dilution
5	5112314-32	2	1 OD x .049 52SO alum. alloy	16-3/4			Surge valve to hose
6	5112313-41 or AN856-4-10	2	1/4 OD x .035 52SO alum. alloy	10-1/4			Oil dilution solenoid to drain tee
7	5112314-31	2	1 OD x .049 52SO alum. alloy	15			Hose to surge valve
8	2202791	2	1 OD x .049 52SO alum. alloy	38-1/2			Line—Oil system "Y"
9	AN855-4 or 5112314-35 or 39B-3480-414	2	1/4 OD x .035 52SO alum. alloy	7-3/4	AF811BT-4D Nut AF811T-4D Sleeve	2 2	Engine to transmitter
10	2131494	1	5/8 ID Weatherhead flex	26-1/2	AN811 swivel-type fitting 7/8-18 int thd AF811CT-10	2	Hose assembly—Propeller feathering flex
11	5112324-14	2	1-1/4 OD x .049 52SO alum. alloy				Tank to "Y" drain

KEY TO FIGURE 627

Item	Part No.	Part Name	No. Req LH	No. Req RH
A	AF811FT-4D	Nipple	1	1
B	Type 4G8-G15D	Hamilton Standard Propeller Governor	1	1
	or			
	Type 4G8-G23D or G		1	1
C	AF878-16-14	Hose	2	2
D	54772-21	Hamilton Standard Pump	1	1
	or			
	54772-2	Hamilton Standard Pump	1	1
E	AF811RT-4D	Tee	1	1
F	AF878-24-14	Hose	1	1
G	1204274	Oil Cooler	1	1

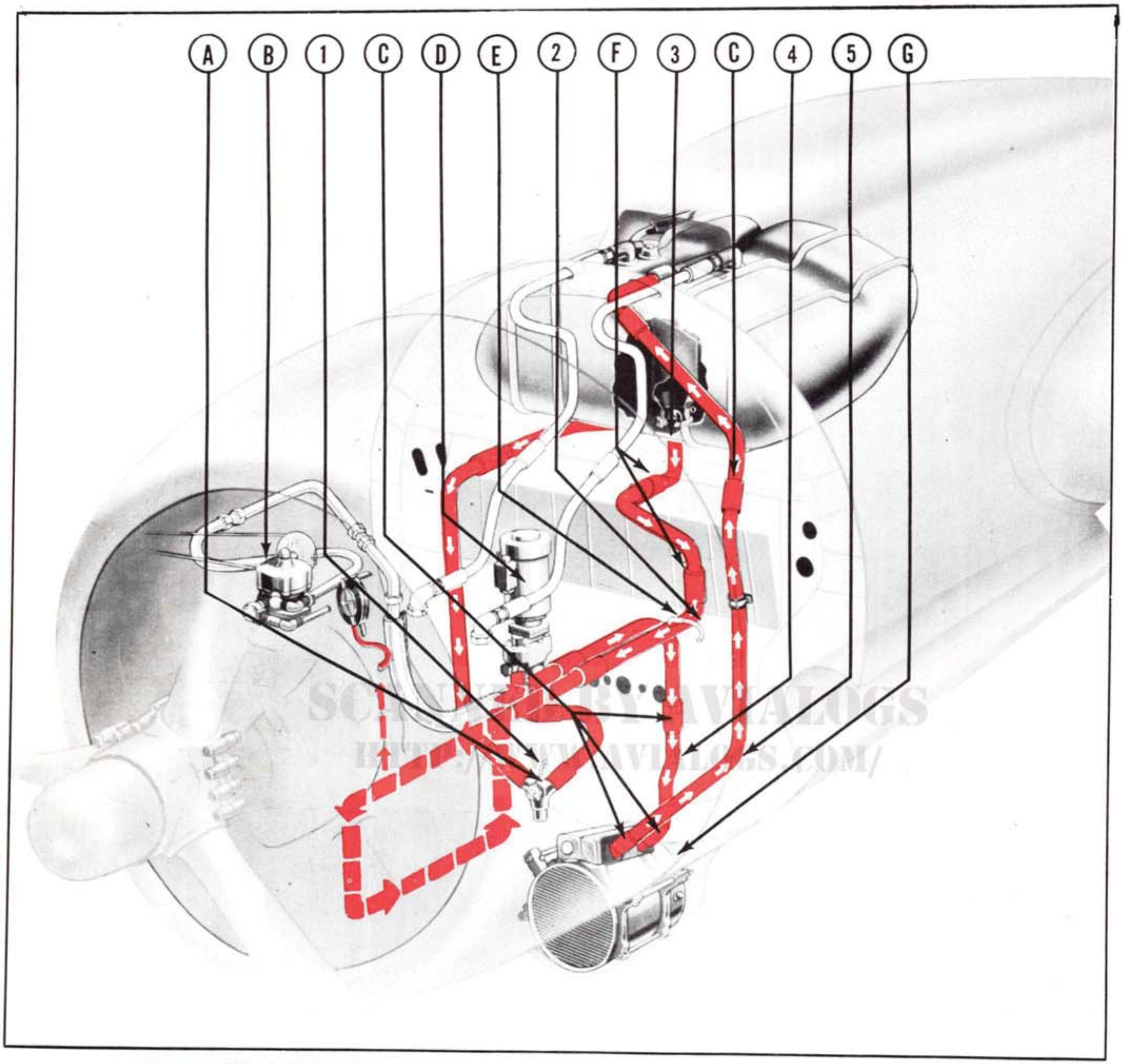


Figure 627—C-47A Oil System (With D-8 Surge Valve and Cooler) (Lines and Fittings)

KEY TO FIGURE 627—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Lines Location*
1	5112313-48	2	1/4 OD x .035 52SO alum alloy	40	AF811BT-4D AF811-T-4D	2 2	Oil dilution Sol to "Y" drain
2	AN856-4-10	2	1/4 OD Alum alloy AN-QQ-A-696	10	AN818-10D	1	Hose Assembly Low pressure Swivel conn
3	5112314-25	2	1-1/2 OD x .049 52SO alum alloy	13			Tank to hose
4	5112314-28	2	1 OD x .049 52SO alum alloy	28			Oil outlet to oil cooler
5	5112314-27	2	1 OD x .049 52SO alum alloy	39			Return—Cooler to hose

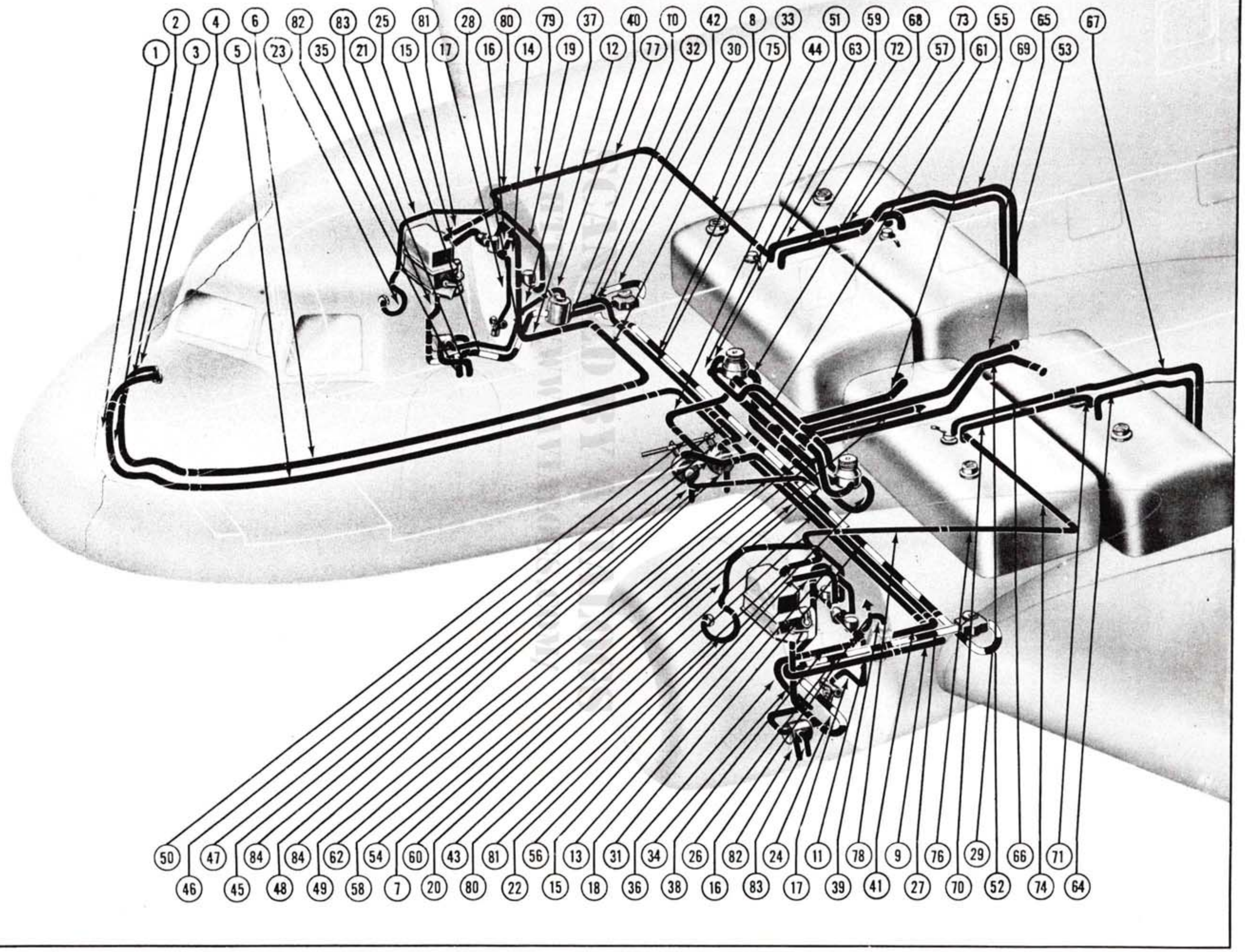

2
4
6
82
83
25
81
28
80
79
37
40
10
42
8
33
51
59
68
73
55
65
67
1
3
5
23
35
21
15
17
16
14
19
12
77
32
30
75
44
63
72
57
61
69
53
50
47
84
84
62
54
60
43
81
56
13
31
34
26
82
24
11
78
9
76
29
66
71
46
45
48
49
58
7
20
80
22
15
18
36
38
16
83
17
39
41
27
70
52
74
64

Figure 628—Fuel System (Lines)

KEY TO FIGURE 628

Item	Part No.	No. Req	Size and Material	Lgth	Fittings	Ftgs per Line	Description
1	5112318-2	1	1/4 OD x .035 52SO	47-1/4	AF811BT-4D AF811T-4CS	2 2	Fuel pressure line Flex hose to fuselage forward plate assembly LH
2	5112318-4	1	1/4 OD x .035 52SO	47-1/2	AF811BT-4D AF811T-4CS	2 2	Fuel pressure line Flex hose to fuselage forward plate assembly RH
3	5116836-15	1	1/4 ID	26-1/2	014D	2	Fuel pressure line
4	5116836-16	1	1/4 ID	23-3/4	014D	2	Fuel pressure line
5	5112318-1	1	1/4 OD x .035 52SO	149-1/4	AF811BT-4D AF811T-4CS	2 2	Fuel pressure line Fuselage forward plate to center—wing LH
6	5112318-3	1	1/4 OD x .035 52SO	149	AF811BT-4D AF811T-4CS	2 2	Fuel pressure line Fuselage forward plate to center—wing RH
7	5112315-46	1	1/4 OD x .035 52SO	118	AF811BT-4D AF811T-4CS	2 2	Fuel pressure line Connector plate in center wing to nacelle LH
8	5112315-41	1	1/4 OD x .035 52SO	61-1/4	AF811BT-4D AF811T-4CS	2 2	Fuel pressure line Connector plate in center wing to nacelle RH
9	5112315-63	1	1/4 OD x .035 52SO	33	AF811BT-4D AF811T-4D	2 2	Fuel pressure line Nacelle to fire wall LH
10	5112315-64	1	1/4 OD x .035 52SO	33	AF811BT-4D AF811T-4D	2 2	Fuel pressure line Nacelle to fire wall RH
11	*5112313-59	1	1/4 OD x .035 52SO	28	AF811BT-4D AF811T-4D	2 2	Fuel pressure line Firewall to tee LH
	**5112313-59	1	1/4 OD x .035 52SO	12-1/2	AF811-BT-4D AF811-T-4CS	2 2	Primer solenoid to firewall plate
12	*5112313-58	1	1/4 OD x .035 52SO	33-1/2	AF811BT-4D AF811T-4D	2 2	Fuel pressure line Fire wall to tee RH
	**5112313-58	1	1/4 OD x .035 52SO	19-1/4	AF811-BT-4D AF811-T-4CS	2 2	Primer solenoid to firewall plate
13	*5112313-52	1	1/4 OD x .035 52SO	12	AF811BT-4D AF811T-4D	2 2	Fuel pressure line—tee to restrictor fitting LH
	**5112313-52	1	1/4 OD x .035 52SO	12	AF811-BT-4D AF811-T-4CS	2 2	LH Oil-Dilution solenoid to primer solenoid
14	*5112313-53	1	1/4 OD x .035 52SO	14	AF811BT-4D AF811T-4D	2 2	Fuel pressure line—tee to restrictor fitting RH
	**5112313-53	1	1/4 OD x .035 52SO	14	AF811-BT-4D AF811-T-4CS	2 2	RH Oil-Dilution solenoid to primer solenoid
15	2119836-1	1	Hose 1/8 ID high pressure flexible	26	Swivel end	2	Fuel pressure line Flex hose-carburetor to restrictor fitting
16	2119836-3	1	Hose 1/8 ID high pressure flexible	10	Swivel end	2	Oil dilution line Flex hose-solenoid to main engine oil line
17	5112313-48	2	1/4 OD x .035 52SO	38-3/4	AF811BT-4D AF811T-4D	2 2	Oil dilution line Solenoid to engine oil "Y" drain
18	5112313-54	1	1/4 OD x .035 52SO	20	AF811BT-4D AF811T-4D	1 1	Primer line—Solenoid to hose connection LH
19	5112313-55	1	1/4 OD x .035 52SO	16-1/2			Primer line—Solenoid to hose connection RH
20	5112313-21	1	1/4 OD x .035 52SO	19-1/4			Primer line—Hose to hose LH
21	5222313-22	1	1/4 OD x .035 52SO	18			Primer line—Hose to hose RH

*C-47 and early C-47A airplanes. **Late C-47A and all C-47B airplanes.

KEY TO FIGURE 628—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs Per Line*	*Description*
22	5112313-30	1	1/4 OD x .035 52SO	14-1/2	AF811BT-4D AF811T-4CS	2 2	Primer line. Hose fitting to to spider LH
23	5112313-20	1	1/4 OD x .035 52SO	18-1/2			Primer line. Hose fitting to spider RH
24	5112313-5	1	3/4 OD x .049 52SO	16-1/4			Cross-feed line. Engine-driven pump to hose LH
25	5112313-6	1	3/4 OD x .049 52SO	32			Cross-feed line. Engine-driven pump to fire wall RH
26	5112313-10	1	3/4 OD x .049 52SO	29-1/2			Cross-feed line. Hose to fire wall LH
27	5112315-28	1	3/4 OD x .049 52SO	40	AF811BT-12D AF811T-12CS	2 2	Cross-feed line. Cross-feed valve to fire wall LH
28	5112315-25	1	3/4 OD x .049 52SO	40-1/2	AF811BT-12D AF811T-12CS	2 2	Cross-feed line. Cross-feed valve to fire wall RH
29	5112315-29	1	3/4 OD x .049 52SO	17-1/2	AF811BT-12D AF811T-12CS	2 2	Cross-feed line. Cross-feed valve to nacelle wall LH
30	5112315-26	1	3/4 OD x .049 52SO	17	AF811BT-12D AF811T-12CS	2 2	Cross-feed line. Cross-feed valve to nacelle wall RH
31	5112315-30	1	3/4 OD x .049 52SO	114	AF811BT-12D AF811T-12CS	2 2	Cross-feed line. Nacelle wall to union LH
32	5112315-25	(Ref item 28)					
33	5112315-27	1	3/4 OD x .049 52SO	57-1/4	AF811BT-12D AF811T-12CS	2 2	Cross-feed line. Nacelle wall to union RH
34	5112313-1	1	3/4 OD x .049 52SO	25-1/2			Main fuel line. Engine-driven pump to carburetor LH
35	5112313-35	1	3/4 OD x .049 52SO	29			Main fuel line. Engine-driven pump to carburetor RH
36	5112313-2	1	3/4 OD x .049 52SO	9-3/4			Main fuel line. Engine-driven pump to hose LH
37	5112313-4	1	3/4 OD x .049 52SO	31-1/2			Main fuel line. Engine-driven pump to hose RH
38	5112313-3	1	3/4 OD x .049 52SO	36-1/2			Main fuel line. Hose to fire wall LH
39	5112315-8	1	3/4 OD x .049 52SO	18	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Fire wall to fuel strainer LH
40	5112315-1	1	3/4 OD x .049 52SO	18-1/4	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Fire wall to fuel strainer RH
41	5112315-9	1	3/4 OD x .049 52SO	21	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Fuel strainer to nacelle wall LH
42	5112315-2	1	3/4 OD x .049 52SO	21	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Fuel strainer to nacelle wall RH
43	5112315-10	1	3/4 OD x .049 52SO	74	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Nacelle wall to centerwing connector plate LH
44	5112315-3	1	3/4 OD x .049 52SO	62	AF811BT-12D AF811T-12CS	2 3	Main fuel line. Nacelle wall to union RH
45	5112315-11	1	3/4 OD x .049 52SO	22-1/2	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Centerwing connector plate to wobble pump LH
46	5112315-4	1	3/4 OD x .049 52SO	38-1/2	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Union to centerwing connector plate RH
47	5112315-5	1	3/4 OD x .049 52SO	10-1/4	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Centerwing connector plate to wobble pump RH

KEY TO FIGURE 628–Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs Per Line*	*Description*
48	5139865-22	1	3/4 OD x .049 52SO	9-1/4	AF811BT-12D AS811T-12CS	2 2	Main fuel line. Wobble pump to "T" LH
49	5139865-24	1	3/4 OD x .049 52SO	16-1/4	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Tee to selector valve LH
50	5139865-25	1	3/4 OD x .049 52SO	16-1/2	AF811BT-12D AF811T-12CS	2 2	Main fuel line. Wobble pump to "T" RH
51	5112315-7	1	3/4 OD x .049 52SO	24	AF811BT-12D AF811T-12CS	2 2	Main fuel line. "T" to selector valve RH
52	5112315-24	1	3/4 OD x .049 52SO	76-1/2	AF811BT-12D AF811T-12CS	2 2	Aux fuel supply. L aux tank to "T" LH
53	5112315-23	1	3/4 OD x .049 52SO	67-1/2	AF811BT-12D AF811T-12CS	2 2	Aux fuel supply. R aux tank to "T" RH
54	5112315-21	1	3/4 OD x .049 52SO	32	AF811BT-12D AF811T-12CS	2 2	Main fuel supply. L main tank to "T" LH
55	5112315-22	1	3/4 OD x .049 52SO	38	AF811BT-12D AF811T-12CS	2 2	Main fuel supply. R main tank to "T" RH
56	5112315-16	1	3/4 OD x .049 52SO	22	AF811BT-12D AF811T-12CS	2 2	LH aux fuel supply. "T" to LH selector valve
57	5112315-20	1	3/4 OD x .049 52SO	15-3/4	AF811BT-12D AF811T-12CS	2 2	LH aux fuel supply. "T" to RH selector valve
58	5112315-15	1	3/4 OD x .049 52SO	12-3/4	AF811BT-12D AF811T-12CS	2 2	RH aux fuel supply. "T" to LH selector valve
59	5112315-19	1	3/4 OD x .049 52SO	18	AF811BT-12D AF811T-12CS	2 2	RH aux fuel supply. "T" to RH selector valve
60	5112315-13	1	3/4 OD x .049 52SO	14	AF811BT-12D AF811T-12CS	2 2	LH main fuel supply. "T" to LH selector valve
61	5112315-17	1	3/4 OD x .049 52SO	16-1/4	AF811BT-12D AF811T-12CS	2 2	LH main fuel supply. "T" to RH selector valve
62	5112315-14	1	3/4 OD x .049 52SO	15	AF811BT-12D AF811T-12CS	2 2	RH main fuel supply. "T" to LH selector valve
63	5112315-18	1	3/4 OD x .049 52SO	13	AF811BT-12D AF811T-12CS	2 2	RH main fuel supply. "T" to RH selector valve
64	5112315-36	1	3/4 OD x .049 52SO	70-1/2			Vent line. Left aux tank to atmosphere
65	5112315-35	1	3/4 OD x .049 52SO	70-1/2			Vent line. Right aux tank to atmosphere
66	5112315-61	1	3/4 OD x .049 52SO	37			Vent line. Left main tank to hose connection
67	5112315-33	1	3/4 OD x .049 52SO	64			Vent line. Hose connection to atmosphere LH
68	5112315-62	1	3/4 OD x .049 52SO	35-1/2			Vent line. Right main tank to hose connection
69	5112315-31	1	3/4 OD x .049 52SO	64			Vent line. Hose connection to atmosphere RH
70	5112315-57	1	3/8 OD x .035 52SO	22	AF811BT-6D AF811T-6CS	1 1	Tank to tank vent. Left main tank to hose
71	5112315-59	1	3/8 OD x .035 52SO	21	AF811BT-6D AF811T-6CS	1 1	Tank to tank vent. Left aux tank to hose
72	5112315-58	1	3/8 OD x .035 52SO	22	AF811BT-6D AF811T-6CS	1 1	Tank to tank vent. Right main tank to hose
73	5112315-60	1	3/8 OD x .035 52SO	21	AF811BT-6D AF811T-6CS	1 1	Tank to tank vent. Right aux tank to hose
74	5112315-53	1	3/8 OD x .035 52SO	46-1/2	AF811BT-6D AF811T-6CS	2 2	Carb return line. Left main tank to elbow
75	5112315-56	1	3/8 OD x .035 52SO	72-1/2	AF811BT-6D AF811T-6CS	2 2	Carb return line. Right main tank to elbow

KEY TO FIGURE 628—Continued

Item	Part No.	No. Req	Size and Material	Lgth	Fittings	Ftgs Per Line	Description
76	5112315-52	1	3/8 OD x .035 52SO	33	AF811BT-6D AF811T-6CS	2 2	Carb return line. Elbow to union LH
77	5112315-55	1	3/8 OD x .035 52SO	33-1/2	AF811BT-6D AF811T-6CS	2 2	Carb return line. Elbow to union RH
78	5112315-51	1	3/8 OD x .035 52SO	33-1/4	AF811BT-6D AF811T-6CS	1 1	Carb return line. Fire wall to union LH
79	5112315-54	1	3/8 OD x .035 52SO	33-1/2	AF811BT-6D AF811T-6CS	1 1	Carb return line. Fire wall to union RH
80	5112315-56	2	3/8 OD x .035 52SO	18			Carb return line. Fire wall to hose connection
81	5112313-57	2	3/8 OD x .035 52SO	13-1/2			Carb return line. Hose connection to carburetor
82	5112313-7	2	1/4 OD x .035 52SO	16-1/2			Fuel pump syphon vent line
83	5112313-16	2	1/4 OD x .035 52SO	17-1/2			Fuel pump drain line
84	5112315-32	2	3/8 OD x .035 52SO	7	AF811BT-6D AF811T-6CS	1 1	Wobble pump vent line

MAIN FUEL SYSTEM LINES
(C-47B and Late C-47A Airplanes)

KEY TO FIGURE 628A

Item	Part No.	Size and Material	Lgth	Fittings	No. Ftgs Req	Remarks
1	5204328-20	1/4 OD x .035 52SO	18-1/2	AAF811-BT-4D AAF811-T-4CS	2 2	Cylinder Primer—Diaphragm to Spider
2	5204328-24	1/4 OD x .035 52SO	10-1/2			Manifold Pressure—Case to Hose RH
3	5204328-26	1/2 OD x .035 52SO	20			Blower Drain—Manifold Case to Atmosphere RH
4	5204328-16	1/4 OD x .035 52SO	17-1/2			Upper Fuel Pump Drain—Hose to Atmosphere RH
5	5204328-22	1/4 OD x .035 52SO	18			Cylinder Primer—Hose to Diaphragm
6	5204328-7	1/4 OD x .035 52SO	16-1/2			Lower Vent Line—Hose to Atmosphere RH
7	5204328-33	1/4 OD x .035 52SO	20-1/4			Manifold Pressure—Hose to Firewall RH
8	5204328-55	1/4 OD x .035 52SO	16-1/2			Cylinder Primer—Solenoid to Hose RH
9	5204328-4	3/4 OD x .049 52SO	32-1/2			Main Fuel Supply—Firewall to Fuel Pump RH
10	5204328-59	1/4 OD x .035 52SO	12-1/2	AAF811-BT-4D	2	Fuel Pressure—Solenoid to Firewall Plate RH
11	5204328-53	1/4 OD x .035 52SO	14	AAF811-BT-4D AAF811-T-4CS	2 2	RH Oil Dilution Solenoid to Primer Solenoid
12	5204328-60	3/4 OD x .049 52SO	29-1/2			Main Fuel Supply—Pump to Carb.
13	5204328-57	3/8 OD x .035 52SO	11			Fuel Vapor Return—Carb. to Hose RH
14	5204328-56	3/8 OD x .035 52SO	18			Fuel Vapor Return—Hose to Firewall RH
15	5204328-48	1/4 OD x .035 52SO	40	AAF811-BT-4D AAF811-T-4CS	2 2	Oil Dilution—Sol. to "Y" Drain RH
16	5204211-49	1/4 OD x .035 52SO	35-1/2	AAF811-BT-4D AAF811-T-4CS	2 2	Manifold Press.—Firewall to Cant. Rib Con. Plate RH

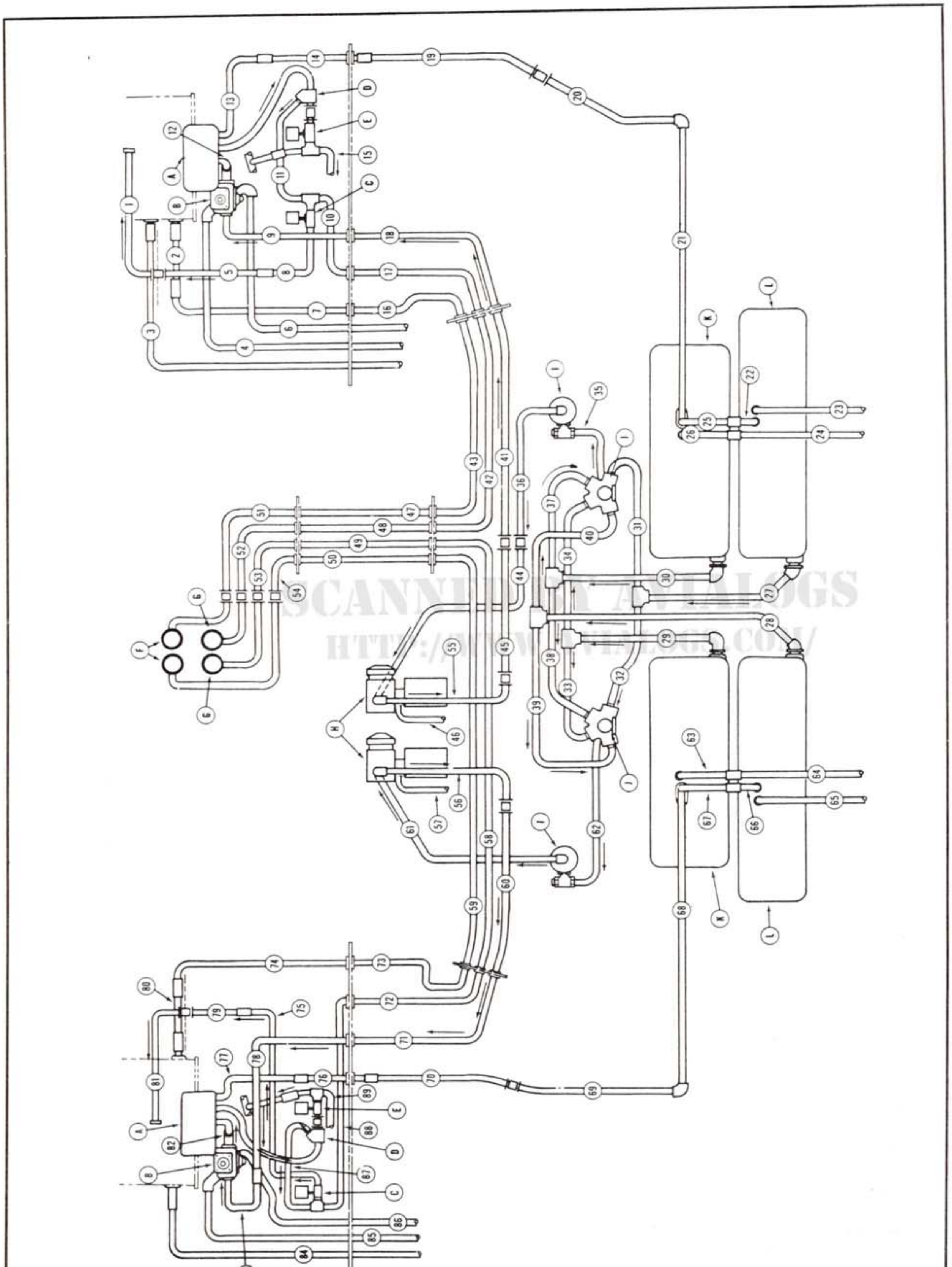

A
B
C
D
E
F
G
H
I
J
K
L
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89

Figure 628A—Late C-47A and C-47B Lines Chart (Also See Figure 289A)

KEY TO FIGURE 628A, LINES—Continued

Item	*Part No.*	*Size and Material*	*Lgth*	*Fittings*	*No. Ftgs Req*	*Remarks*
17	5204211-39	1/4 OD x .035 52SO	33-7/8	AAF811-BT-4D AAF811-T-4CS	2 2	Fuel Pressure—RH Firewall to Cant. Rib
18	5204211-1	3/4 OD x .049 52SO	45	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Firewall Cant. Rib RH
19	5204211-54	3/8 OD x .035 52SO	20	AAF811-BT-6D AAF811-T-6CS	1	Carburetor Drain—Firewall to Union RH
20	5204211-55	3/8 OD x .035 52SO	33-1/2	AAF811-BT-6D AAF811-T-6CS	2 2	Carburetor Drain—Union to Elbow RH
21	5204211-56	3/8 OD x .035 52SO	72-1/2	AAF811-BT-6D AAF811-T-6CS	2	Carburetor Drain—Elbow to Tank RH
22	5204211-60	3/8 OD x .035 52SO	21	AAF811-BT-6D AAF811-T-6CS	1 1	Inter Tank Vent—RH Aux. Tank to Hose
23	5204211-35	3/4 OD x .049 52SO	70-1/2			RH Aux. Fuel Tank Vent—Tank to Atmosphere
24	5204211-31	3/4 OD x .049 52SO	64			RH Main Fuel Tank Vent—Hose to Atmosphere
25	5204211-58	3/8 OD x .035 52SO	22	AAF811-BT-6D AAF811-T-6CS	1 1	Inter Tank Vent—RH Main Tank to Hose
26	5204211-62	3/4 OD x .049 52SO	35-1/2			RH Main Fuel Tank Vent—Tank to Hose
27	5204211-23	3/4 OD x .049 52SO	67-1/2	AAF811-BT-12D AAF811-T-12CS	2 2	Right Aux. Supply—Fuel Tank to Tee
28	5204211-24	3/4 OD x .049 52SO	76-1/2	AAF811-BT-12D AAF811-T-12CS	2 2	Left Aux. Supply—Fuel Tank to Tee
29	5204211-21	3/4 OD x .049 52SO	32	AAF811-BT-12D AAF811-T-12CS	2 2	Left Main Supply—Fuel Tank to Tee
30	5204211-22	3/4 OD x .049 52SO	38	AAF811-BT-12D AAF811-T-12CS	2 2	Right Main Supply—Fuel Tank to Tee
31	5204211-19	3/4 OD x .049 52SO	21	AAF811-BT-12D AAF811-T-12CS	2 2	Right Aux. Supply—Tee to RH Selector Valve
32	5204211-15	3/4 OD x .049 52SO	12-3/4	AAF811-BT-12D AAF811-T-12CS	2 2	Right Aux. Supply—Tee to LH Selector Valve
33	5204211-25	3/4 OD x .049 52SO	17	AAF811-BT-12D AAF811-T-12CS	2 2	Left Main Supply—Tee to Left Selector Valve
34	5204211-17	3/4 OD x .049 52SO	16-1/4	AAF811-BT-12D AAF811-T-12CS	2 2	Left Main Supply—Tee to Right Selector Valve
35	5204211-7	3/4 OD x .049 52SO	14-1/2	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Selector Valve to Strainer RH
36	5204211-6	3/4 OD x .049 52SO	26	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Strainer to Union Right
37	5204211-18	3/4 OD x .049 52SO	13	AAF811-BT-12D AAF811-T-12CS	2 2	Right Main Supply—Tee to Selector Valve
38	5204211-14	3/4 OD x .049 52SO	15	AAF811-BT-12D AAF811-T-12CS	2 2	Right Main Supply—Tee to Left Selector Valve
39	5204211-16	3/4 OD x .049 52SO	23	AAF811-BT-12D AAF811-T-12CS	2 2	Left Aux. Supply—Tee to Left Selector Valve
40	5204211-20	3/4 OD x .049 52SO	15-3/4	AAF811-BT-12D AAF811-T-12CS	2 2	Left Aux. Supply—Tee to Right Selector Valve
41	5204211-3	3/4 OD x .049 52SO	62	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Union to Cant. Rib Con. Plate RH
42	5204211-41	1/4 OD x .035 52SO	61-1/4	AAF811-BT-4D AAF811-T-4CS	2 2	Fuel Pressure—RH Cant. Rib Con. Plate to Fus. Aft Con. Plate
43	5204211-50	1/4 OD x .035 52SO	64-1/2	AAF811-BT-4D AAF811-T-4CS	2	Manifold Press.—RH Cant. Rib Con. Plate—To Fus. Aft Con. Plate

KEY TO FIGURE 628A, LINES—Continued

Item	*Part No.*	*Size and Material*	*Lgth*	*Fittings*	*No. Ftgs Req*	*Remarks*
44	5204211-9	3/4 OD x .049 52SO	31-1/2	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Union to Booster Pump—RH
45	5204211-4	3/4 OD x .049 52SO	38-1/2	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Union to Union RH
46	5204211-32	1/4 OD x .035 52SO	10			RH Booster Pump—Vent to Atmosphere
47	5112318-7	1/4 OD x .035 52SO	146-3/4	AAF811-BT-4D AAF811-C-4CS	2 2	RH Manifold Press.—Fus. Tunnel Aft Con. Panel to Fus. Tunnel Forward Con. Panel
48	5112318-3	1/4 OD x .035 52SO	149	AAF811-BT-4D AAF811-T-4CS	2 2	RH Fuel Press. Gage Fus. Tunnel Aft. Con. Panel to Fus. Tunnel Forward Con. Panel
49	5112318-1	1/4 OD x .035 52SO	149-1/4	AAF811-BT-4D AAF811-T-4CS	2 2	LH Fuel Press. Gage Tunnel Aft Con. Panel to Fus. Tunnel Forward Con. Panel
50	5112318-5	1/4 OD x .035 52SO	146-3/8	AAF811-BT-4D AAF811-T-4CS	2 2	LH Manifold Press. Fus. Tunnel Aft Con. Panel to Fus. Tunnel
51	5112318-8	1/4 OD x .035 52SO	49	AAF811-BT-4D AAF811-T-4CS	2 2	RH Manifold Press. Fus. Tunnel Forward Con. Panel to Flex Hose
52	5112318-4	1/4 OD x .035 52SO	47-1/2	AAF811-BT-4D AAF811-T-4CS	2 2	RH Fuel Press. Gage Fus. Tunnel Forward Con. Panel to Flex Hose
53	5112318-2	1/4 OD x .035 52SO	47-1/4	AAF811-BT-4D AAF811-T-4CS	2 2	LH Fuel Press. Gage Fus. Tunnel Forward Con. Panel to Flex Hose
54	5112318-6	1/4 OD x .035 52SO	50	AAF811-BT-4D AAF811-T-4CS	2 2	LH Manifold Press. Fus. Tunnel Forward Con. Panel to Flex Hose
55	5204211-5	3/4 OD x .049 52SO	24	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Booster Pump to Union RH
56	5204211-11	3/4 OD x .049 52SO	27-1/2	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Booster Pump to Union LH
57	5204211-34	1/4 OD x .035 52SO	6			LH Booster Pump—Vent to Atmosphere
58	5204211-46	1/4 OD x .035 52SO	118	AAF811-BT-4D AAF811-T-4CS	2 2	Fuel Press.—LH Cant. Rib Con. Plate to Fus. Aft Con. Plate
59	5204211-48	1/4 OD x .035 52SO	116-3/4	AAF811-BT-4D AAF811-T-4CS	2 2	Manifold Press.—Cant. Rib Con. Plate to LH Fus. Aft Con. Plate
60	5204211-10	3/4 OD x .049 52SO	74	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Union Cant. Rib Con. Plate LH
61	5204211-13	3/4 OD x .049 52SO	29-1/2	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Strainer to Booster Pump LH
62	5204211-12	3/4 OD x .049 52SO	14-1/2	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Selector Valve to Strainer LH
63	5204211-61	3/4 OD x .049 52SO	37			LH Main Fuel Tank Vent—Tank to Hose
64	5204211-33	3/4 OD x .049 52SO	64			LH Main Fuel Tank Vent—Hose to Atmosphere
65	5204211-36	3/4 OD x .049 52SO	70-1/2			LH Aux. Fuel Tank Vent—Tank to Atmosphere
66	5204211-59	3/8 OD x .035 52SO	21	AAF811-BT-6D AAF811-T-6CS	1 1	Inter Tank Vent—LH Aux. Tank to Hose

KEY TO FIGURE 628A—Continued

Item	*Part No.*	*Size and Material*	*Lgth*	*Fittings*	*No. Ftgs Req*	*remarks*
67	5204211-57	3/8 OD x .035 52SO	22	AAF811-BT-6D AAF811-T-6CS	1 1	Inter Tank Vent—LH Main Tank to Hose
68	5204211-53	3/8 OD x .035 52SO	46-1/2	AAF811-BT-6D AAF811-T-6CSS	2 2	Carburetor Drain Elbow to Tank LH
69	5204211-52	3/8 OD x .035 52SO	33	AAF811-BT-6D AAF811-T-6CS	2 2	Carburetor Drain—Union to Elbow LH
70	5204211-51	3/8 OD x .035 52SO	30-3/4	AAF811-BT-6D AAF811-T-6CS	1 1	Carburetor Drain—Firewall to Union LH
71	5204211-8	3/4 OD x .049 52SO	45	AAF811-BT-12D AAF811-T-12CS	2 2	Main Fuel Supply—Cant. Rib to LH Firewall
72	5204211-44	1/4 OD x .035 52SO	35-3/8	AAF811-BT-4D AAF811-T-4CS	2 2	Fuel Pressure—LH Firewall to Cant. Rib
73	5204211-47	1/4 OD x .035 52SO	35	AAF811-BT-4D AAF811-T-4CS	2 2	Manifold Pressure—Firewall to Cant. Rib Con. Plate LH
74	5204328-34	1/4 OD x .035 52SO	20-1/4			Manifold Pressure—Hose to Firewall
75	5204238-54	1/4 OD x .035 52SO	20			Cylinder Primer Solenoid to Hose LH
76	5204328-56	3/8 OD x .035 52SO	18			Fuel Vapor Return—Hose to Firewall
77	5204328-57	3/8 OD x .035 52SO	11			Fuel Vapor Return—Carb. to Hose
78	5204328-62	3/4 OD x .049 52SO	32-1/2			Main Supply—Firewall to Hose LH
79	5204328-21	1/4 OD x .035 52SO	19-1/4			Cylinder Primer—Hose to Diaphragm LH
80	5204328-23	1/4 OD x .035 52SO	12-1/4			Manifold Pressure—Case to Hose LH
81	5204328-30	1/4 OD x .035 52SO	14-1/2	AAF811-BT-4D AAF811-T-4CS	2 2	Cylinder Primer—Diaphragm to Spider LH
82	5204328-60	3/4 OD x .049 52SO	29-1/2			Main Fuel Supply—Pump to Carb.
83	5204328-61	3/4 OD x .049 52SO	21			Main Fuel Supply—Hose to Fuel Pump
84	5204328-26	1/2 OD x .035 52SO	20			Blower Drain—Case to Atmosphere
85	5204328-16	1/4 OD x .035 52SO	17-1/2			Upper Fuel Pump Drain—Hose to Atmosphere
86	5204328-7	1/4 OD x .035 52SO	16-1/2			Lower Vent Line—Hose to Atmosphere
87	5204328-52	1/4 OD x .035 52SO	12	AAF811-BT-4D AAF811-T-4CS	2 2	LH Oil Dilution Solenoid to Primer Solenoid
88	5204328-58	1/4 OD x .035 52SO	19-1/4	AAF811-BT-4D AAF811-T-4CS	2 2	Fuel Pressure—Solenoid to Firewall Plate LH
89	5204328-48	1/4 OD x .035 52SO	40	AAF811-BT-4D AAF811-T-4CS	2 2	Oil Dilution—Solenoid "Y" Drain LH

FUEL SYSTEM LINE FITTINGS
(C-47B and Late C-47A Airplanes)

KEY TO FIGURE 628A

Item	*Part No.*	*Part Name*	*Location*	*No. Req*
1	Parker 3117-4T-4D	Connector	At Diaphragm	1
	Parker 11-1039-1-2D	Locknut	At Diaphragm	1
	AAF811CT-4	Elbow	At Spider	1

KEY TO FIGURE 628A, FITTINGS—Continued

Item	*Part No.*	*Part Name*	*Location*	*No. Req*
2	AN884-4-12	Hose	Each End of Line	2
	Wittek FB-4	Clamp	Each End of Line	4
	S 148779-851-4-55	Hose Elbow	At Manifold	1
	AAF895-80	Reducer	At Manifold	1
3	AN884-8-12	Hose	At Manifold Case	1
	Wittek FB-8	Clamp	At Manifold Case	2
	AN844-8	45° Hose Elbow	At Manifold Case	1
4	AN884-4-12	Hose	At Fuel Pump	1
	Wittek FB-4	Clamp	At Fuel Pump	2
	AN842-4	Hose Elbow	At Fuel Pump	1
5	AN884-4-12	Hose	Each End of Line	2
	Wittek FB-4	Clamp	Each End of Line	4
6	AN884-4-12	Hose	At Fuel Pump Lower Vent	1
	Wittek FB-4	Clamp	At Fuel Pump Lower Vent	2
	S 148779-851-4-60	Fitting Assem.	At Fuel Pump Lower Vent	1
7	AN884-4-12	Hose	At Firewall Connector Plate	1
	Wittek FB-4	Clamp	At Firewall Connector Plate	2
8	AN842-4	Elbow	At Solenoid	1
	AN884-4-12	Hose	At Solenoid	1
	Wittek FB-4	Clamp	At Solenoid	2
9	AN884-12-12	Hose	At Firewall	1
	Wittek FB-12	Clamp	At Firewall	2
	AN884-12-12	Hose	At Fuel Pump	1
	Wittek FB-12	Clamp	At Fuel Pump	2
	AN842-12	Elbow	At Fuel Pump	1
10	SEE ITEM 11 & 17			
11	AAF811ST-4	Tee	At Engine Primer Solenoid	1
12	AN884-12-12	Hose	At Fuel Pump	1
	Wittek FB-12	Clamp	At Fuel Pump	2
	AN842-12	Hose Elbow	At Fuel Pump	1
	AN884-12-12	Hose	At Carburetor	1
	Wittek FB-12	Clamp	At Carburetor	2
	AN844-12	Elbow	At Carburetor	1
13	AN844-4	Elbow	At Carburetor	1
	AN884-6-12	Hose	At Carburetor	1
	Wittek FB-6	Clamp	At Carburetor	2
14	AN884-6-12	Hose	At End of Line Near Carb.	1
	Wittek FB-6	Clamp	At End of Line Near Carb.	2
	AN884-6-12	Hose	At End of Line in RH Nacelle, Behind Firewall	1
	Wittek FB-6	Clamp	At End of Line in RH Nacelle, Behind Firewall	2
15	AAF811FT-4	Nipple	In Top of "Y" Drain	1
16	Parker 3117-4T-4D	Coupling	At Firewall Disconnect Plate RH	1
	Parker 11-1039-1-2D	Locknut	At Firewall Disconnect Plate RH	1
	Parker 3115-1HT-4D	Coupling	At Cant. Rib Connector Plate RH	1
	Parker 11-1039-1-3D	Locknut	At Cant. Rib Connector Plate, RH	1
17	Parker 3115-1HT-4D	Coupling	At RH Firewall Disconnect Plate	1
	Parker 11-1039-1-3D	Locknut	At RH Firewall Disconnect Plate	1
	Parker 3115-1HT-4D	Coupling	At RH Cant. Rib Connector Plate	1
	Parker 311-1039-1-3D	Locknut	At RH Cant. Rib Connector Plate	1
18	Parker 3117-4T-12D	Coupling	At RH Firewall Disconnect Plate	1
	Parker 11-1039-1-14D	Locknut	At RH Firewall Disconnect Plate	1
	Parker 3115-1HT-12D	Coupling	At RH Cant. Rib Connector Plate	1
	Parker 11-1039-19D	Locknut	At RH Cant. Rib Connector Plate	1
19	AAF811-HT-6	Union	In Nacelle near Leading Edge of Center Wing	1
20	AAF811ET-6	Fitting	Aft of Front Spar	1

KEY TO FIGURE 628A, FITTINGS—Continued

Item	*Part No.*	*Part Name*	*Location*	*No. Req*
21	AAF811-RT-6	Fitting	At Tank	1
22	AAF811-FT-6	Fitting	At Tank	1
23	AAF835-12	Nipple	At Tank	1
	AN884-12-12	Hose	At Tank	1
	Wittek FB-10	Clamp	At Tank	2
25	AN884-6-12	Hose	Between R. Main & R. Auxiliary Fuel Tanks See Item 21	1
	FB-6	Nocout Clamp	Between R. Main & R. Auxiliary Fuel Tanks See Item 21	2
26	AAF835-12	Nipple	At Tank	1
	AN884-12-12	Hose	At Tank	1
	Wittek FB-10	Clamp	At Tank	2
	AN884-12-12	Hose	At Connection With Item 24 Line	1
	Wittek FB-10	Clamp	At Connection With Item 24 Line	2
27	AAF895-87	Reducing Bushing	At Tank Sump	1
	Parker 12-CCT	Elbow	At Tank Sump	1
	AAF811 JT-12D	Tee	At Connection to Selector Valves	1
28	AAF895-87	Reducing Bushing	At Tank Sump	1
	AAF811 CT45-12	Elbow	At Tank Sump	1
	AAF811 JT-12D	Tee	At Connection to Selector Valves	1
29	AAF895-87	Reducing Bushing	At Tank Sump, Left Main	1
	Parker 12-CCT	Elbow	At Tank Sump, Left Main	1
	AAF811 JT-12D	Tee	At Connection to Selector Valves	1
30	AAF895-87	Reducing Bushing	At Tank Sump, Right Main	1
	AAF811 CT-45-12	Elbow	At Tank Sump, Right Main	1
	AAF811-JT-12D	Tee	At Connection to Selector Valves	1
31	AAF811 CT-12D	Elbow	At RH Selector Valve	1
32	AAF811 CT-12D	Elbow	At LH Selector Valve	1
33	AAF811 CT-12D	Elbow	At LH Selector Valve	1
34	AAF811 CT-12D	Elbow	At RH Selector Valve	1
35	AAF811 FT-12	Nipple	Bottom of RH Selector Valve	1
	AAF811 ST-12	Tee	Aft Side of Strainer	1
36	AAF811 CT-12	Elbow	On Top of Strainer	1
	AAF811 HT-12D	Union	At Connection to Item 44 Line	1
37	AAF811 CT-12	Elbow	At RH Selector Valve	1
38	AAF811 CT45-12	Elbow	At LH Selector Valve	1
39	AAF811 CT-12	Elbow	At LH Selector Valve	1
40	AAF811 CT-12	Elbow	At RH at Selector Valve	1
41	AAF811 HT-12D	Union	At Connection with Item 45 Line	1
44	AAF811 CT-45-12	Elbow	At Booster Pump Upper Right	1
46	AN844-4D	Elbow	At Fuel Booster Pump Vent	1
	AN884-4-12	Hose	At Fuel Booster Pump Vent	1
	Wittek FB-4	Clamp	At Fuel Booster Pump Vent	2
47	Parker 3115-1HT-4D	Coupling	At RH Fuselage Fwd. Tunnel Connector Plate	1
	Parker 11-1039-1-3D	Locknut	At RH Fuselage Fwd. Tunnel Connector Plate	1
	Parker 3115-1HT-4D	Coupling	At RH Fuselage Aft Tunnel Connector Plate	1
	Parker 11-1039-1-3D	Locknut	At RH Fuselage Aft Tunnel Connector Plate	1
48	Parker 3115-1HT-4D	Coupling	At RH Fuselage Fwd. Tunnel Connector Plate	1
	Parker 11-1039-1-3D	Locknut	At RH Fuselage Fwd. Tunnel Connector Plate	1
	Parker 3115-1HT-4D	Coupling	At RH Fuselage Aft Tunnel Connector Plate	1
	Parker 11-1039-1-3D	Locknut	At RH Fuselage Aft Tunnel Connector Plate	1
49	Parker 3115-1HT-4D	Coupling	At RH Fuselage Fwd. Tunnel Connector Plate	1
	Parker 11-1039-1-3D	Locknut	At RH Fuselage Fwd. Tunnel Connector Plate	1
	Parker 3115-1HT-4D	Coupling	At RH Fuselage Aft Tunnel Connector Plate	1
	Parker 11-1039-1-3D	Locknut	At RH Fuselage Aft Tunnel Connector Plate	1

KEY TO FIGURE 628A, FITTINGS—Continued

Item	*Part No.*	*Part Name*	*Location*	*No. Req*
50	Parker 3115-1HT-4D	Coupling	At RH Fuselage Fwd. Tunnel Connector Plate	1
	Parker 11-1039-1-3D	Locknut	At RH Fuselage Fwd. Tunnel Connector Plate	1
	Parker 3115-1HT-4D	Coupling	At RH Fuselage Aft Tunnel Connector Plate	1
	Parker 11-1039-1-3D	Locknut	At RH Fuselage Aft Tunnel Connector Plate	1
51	Parker 3115-HT-4D	Union	At Servo Line Connector or Beginning of Flex. Hose.	1
	Parker 11-1039-1-3D	Locknut	At Servo Line Connector or Beginning of Flex Hose	1
52	Parker 3115-1HT-4D	Coupling	At (Bracket) Connector	1
	Parker 11-1039-1-3D	Locknut	At (Bracket) Connector	1
53	Parker 3115-1HT-4D	Coupling	At (Bracket) Connector	1
	Parker 11-1039-1-3D	Locknut	At (Bracket) Connector	1
54	Parker 3115-1HT-4D	Union	At Servo Line Connector or Beginning of Flex Hose	1
	Parker 11-1039-1-3D	Locknut	At Servo Line Connector or Beginning of Flex Hose	1
55	AAF811 CT-12	Elbow	At Booster Pump	1
	AAF811 HT-12D	Union	Between Item #55 & 45 Lines	1
56	AAF811 CT-12	Elbow	At Booster Pump	1
	AAF811 HT-12D	Union	Connecting Item #56 & 60 Lines	1
57	AN844-4D	Elbow	At Fuel Booster Pump LH	1
	AN884-4-12	Hose	At Fuel Booster Pump LH	1
	Wittek FB-4	Clamp	At Fuel Booster Pump LH	2
61	AAF811 CT45-12D	Elbow	At Booster Pump LH	1
	AAF811 CT-12	Elbow	At LH Fuel Strainer	1
62	AAF811 FT-12D	Nipple	At Selector Valve	1
	AAF811 ST-12	Tee	At Fuel Strainer	1
63	AAF835-12	Nipple	At Tank	1
	AN884-12-12	Hose	At Tank	1
	Wittek FB-10	Clamp	At Tank	2
	AN884-12-12	Hose	At Connection With Item 64	1
	Wittek FB-10	Clamp	At Connection With Item 64	1
65	AAF835-12	Nipple	At Tank	1
	AN884-12-12	Hose	At Tank	1
	Wittek FB-10	Clamp	At Tank	2
66	AAF811 FT-6	Fitting	At Tank	1
67	AN884-6-12	Hose	Between L. Main & L. Aux. Fwd. Tanks See Item #68	1
	FB-6	Nocout Clamp	Between L. Main & L. Aux. Fwd. Tanks See Item #68	2
68	AAF811-RT-6	Fitting	At Tank	1
69	AAF811-ET6	Fitting	At Front Spar	1
70	AAF811-HT-6	Union	In Nacelle Near Leading Edge of Center Wing	1
71	Parker 3117-4T-12D	Coupling	At RH Firewall Disconnect Plate	1
	Parker 11-1039-14D	Locknut	At RH Firewall Disconnect Plate	1
	Parker 3115-1HT-12D	Coupling	At RH Cant. Rib Connector Plate	1
	Parker 11-1039-1-19D	Locknut	At RH Cant. Rib Connector Plate	1
72	Parker 3115-1HT-4D	Coupling	At Firewall Connector Plate LH	1
	Parker 11-1039-1-3D	Locknut	At Firewall Connector Plate LH	1
	Parker 3115-1HT-4D	Coupling	At LH Cant. Rib Connector	1
	Parker 11-1039-1-3D	Locknut	At LH Cant. Rib Connector	1
73	Parker 3117-4T-4D	Coupling	At LH Firewall Line Disconnect Plate	1
	Parker 11-1039-1-3D	Locknut	At LH Firewall Line Disconnect Plate	1
	Parker 3115-1HT-4D	Coupling	At LH Cant. Rib Connector Plate	1
	Parker 11-1039-1-3D	Locknut	At LH Cant. Rib Connector Plate	1
74	AN884-4-12	Hose	At Firewall Connector Plate	1
	Wittek FB-4	Clamp	At Firewall Connector Plate	2

KEY TO FIGURE 628A, FITTINGS—Continued

Item	*Part No.*	*Part Name*	*Location*	*No. Req*
75	AN842-4	Elbow	At Solenoid	1
76	AN884-6-12	Hose	At End of Line Near Carb.	1
	Wittek FB-6	Clamp	At End of Line Near Carb.	2
	AN884-6-12	Hose	At End of Line in LH Nacelle, Behind Firewall	1
	Wittek FB-6	Clamp	At End of Line in LH Nacelle, Behind Firewall	2
77	AN844-4	Elbow	At Carburetor	1
	AN884-6-12	Hose	At Carburetor	1
	Wittek FB-6	Clamp	At Carburetor	2
79	AN884-4-12	Hose	Each End of Line	2
	Wittek FB-4	Clamp	Each End of Line	4
80	AN884-4-12	Hose	Each End of Line	2
	Wittek FB-4	Clamp	Each End of Line	4
	S 148779-851-4-55	Hose Elbow	At Manifold	1
	AAF895-80	Reducer	At Manifold	1
81	Parker 3117-4T-4D	Connector	At Diaphragm	1
	Parker 11-1039-1-2D	Locknut	At Diaphragm	1
	AAF811 CT-4	Elbow	At Spider	1
82	AN884-12-12	Hose	At Fuel Pump	1
	Wittek FB-12	Clamp	At Fuel Pump	2
	AN842-12	Elbow	At Fuel Pump	1
	AN884-12-12	Hose	At Carburetor	1
	Wittek FB-12	Clamp	At Carburetor	2
	AN844-12D	Elbow	At Carburetor	1
83	AN884-12-12	Hose	At Connection with Item 78	1
	Wittek FB-12	Clamp	At Connection with Item 78	2
84	AN884-8-12	Hose	At Main Case	1
	Wittek FB-8	Clamp	At Main Case	2
	AN844-8	45° Hose Elbow	At Main Case	1
85	AN884-4-12	Hose	At Fuel Pump	1
	Wittek FB-4	Clamp	At Fuel Pump	2
	AN842-4	Hose Elbow	At Fuel Pump	1
86	AN884-4-12	Hose	At Fuel Pump Lower Vent	1
	Wittek FB-4	Clamp	At Fuel Pump Lower Vent	2
	S 148779-851-4-60	Fitting Assem.	At Fuel Pump Lower Vent	1
87	AAF811 ST-4	Tee	At Eng. Primer Solenoid	1
89	AAF811 FT-4	Nipple	In Top of "Y" Drain	1

FERRY FUEL SYSTEM LINES
(C-47A and C-47B Airplanes)

KEY TO FIGURE 628B

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*No. Ftgs Req*	*Location*
1	5-72581-43	1	5/8 OD x .042	92-11/16	AAF811-BT-10D	1	Aft Section Vent, RH
			52SO		AAF811-T-10CS	1	Union to Outlet at Skin
2	5139865-18	1	5/8 OD x .042	17-1/2	AAF811-BT-10D	1	Fwd. Section Vent, LH—
			52SO		AAF811-T-10CS	1	Union to Skin Outlet
3	5139865-23	1	5/8 OD x .042	17-1/2	AAF811-BT-10D	1	Fwd. Section Vent, RH—
			52SO		AAF811-T-10CS	1	Union to Skin Outlet
4	5139865-17	1	5/8 OD x .042	65	AAF811-BT-10D	2	RH Fwd. Tank Vent,
			52SO		AAF811-T-10CS	2	Union to Union
5	5139865-75	1	3/4 OD x .049	27-3/4	AAF811-BT-12D	2	RH Valve to Union
			52SO		AAF811-T-12CS	2	Under Floor
6	5139865-74	1	3/4 OD x .049	29	AAF811-BT-12D	2	LH Valve to Union
			52SO		AAF811-T-12CS	2	Under Floor
7	5139865-8	1	5/8 OD x .042	65	AAF811-BT-10D	2	LH Fwd. Tank
			52SO		AAF811-T-10CS	2	Vent—Union to Union

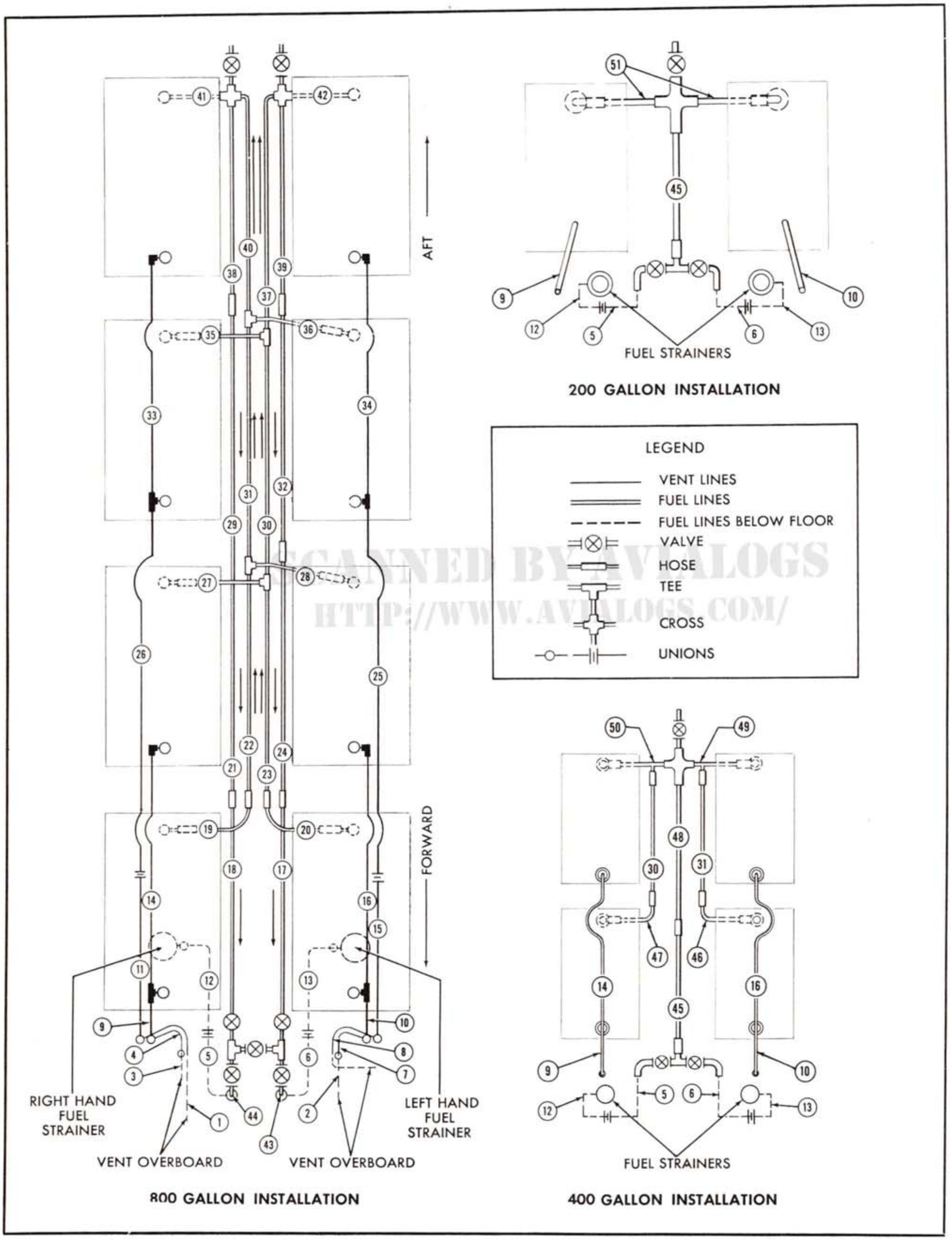

AFT
FORWARD
41
42
40
39
38
37
36
35
33
34
31
32
29
30
27
28
26
25
22
24
21
23
19
20
18
17
14
16
15
11
12
13
9
10
4
8
3
7
5
6
1
2
44
43
RIGHT HAND FUEL STRAINER
VENT OVERBOARD
VENT OVERBOARD
LEFT HAND FUEL STRAINER
800 GALLON INSTALLATION
51
45
9
10
12
5
6
13
FUEL STRAINERS
200 GALLON INSTALLATION
LEGEND
VENT LINES
FUEL LINES
FUEL LINES BELOW FLOOR
VALVE
HOSE
TEE
CROSS
UNIONS
50
49
48
30
31
47
46
14
16
45
9
10
5
6
12
13
FUEL STRAINERS
400 GALLON INSTALLATION

Figure 628B—Ferry Fuel System Lines Chart

KEY TO FIGURE 628B, LINES—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*No. Ftgs Req*	*Location*
8	5-72581-44	1	5/8 OD x .042 52SO	90-1/16	AAF811-BT-10D AAF811-T-10CS	1 1	Aft. Section Vent, LH—Union to Skin Outlet
9	5139865-5	1	5/8 OD x .042 52SO	36-1/2	AAF811-BT-10D AAF811-T-10CS	2 2	RH Fwd. Tank Vent—Tee to Union
10	5139865-5	1	5/8 OD x .042 52SO	36-1/2	AAF811-BT-10D AAF811-T-10CS	2 2	LH Fwd. Tank Vent—Tee to Union
11	5-72581-47	1	5/8 OD x .042 52SO	82-1/2	AAF811-BT-10D AAF811-T-10CS	2 2	Aft Section Vent, RH—Union to Union
12	5139865-77	1	3/4 OD x .049 52SO	33-1/2	AAF811-BT-12D AAF811-T-12CS	2 2	Union to Strainer, RH—Union to Union
13	5139865-76	1	3/4 OD x .049 52SO	33	AAF811-BT-12D AAF811-T-12CS	2 2	Union to Strainer LH
14	5-72581-1	1	5/8 OD x .042 52SO	61	AAF811-BT-10D AAF811-T-10CS	2 2	Fwd. Inter Tank Vent—Elbow to Tee, RH
15	5-72581-45	1	5/8 OD x .042 52SO	84	AAF811-BT-10D AAF811-T-10CS	2 2	Aft Section Vent, LH—Union to Union
16	5-72581-1	1	5/8 OD x .042 52SO	61	AAF811-BT-10D AAF811-T-10CS	2 2	Fwd. Inter Tank Vent—Elbow to Tee, LH
17	5-834519-16	1	1 OD x .049 52SO	50-1/4			LH Valve to Hose
18	5-834519-16	1	1 OD x .049 52SO	50-1/4			RH Valve to Hose
19	5-834519-8	1	1 OD x .049 52SO	22-1/2			Fwd. Tank to Hose, RH
20	5-834519-6	1	1 OD x .049 52SO	22-1/2			Fwd. Tank to Hose, LH
21	5-72581-10	1	1 OD x .049 52SO	55			Return—Center Fwd.—Hose to Hose, RH
22	5-72581-12	1	1 OD x .049 52SO	57-1/2			Center Fwd.—Tee to Hose, RH
23	5-72581-11	1	1 OD x .049 52SO	53-1/2			Center Fwd.—Hose to Tee LH
24	5-72581-10	1	1 OD x .049 52SO	55			Return—Center Fwd. Hose to Hose LH
25	5-72581-46	1	5/8 OD x .042 52SO	69 1/2	AAF811-BT-10D AAF811-T-10CS	2 2	Aft Section Vent, LH—Tee to Union
26	5-72581-46	1	5/8 OD x .042 52SO	69 1/2	AAF811-BT-10D AAF811-T-10CS	2 2	Aft Section Vent, RH Tee to Union
27	5-835419-2	1	1 OD x .049 52SO	22 7/8			Center Fwd. Tank, RH to Tee left side
28	5-834519-4	1	1 OD x .049 52SO	23 1/2			LH Fwd. Center Tank to Tee, Right Side
29	5-72581-9	1	1 OD x .049 52SO	54			Return Line—RH Center to Aft Section
30	5-72581-13	1	1 OD x .049 52SO	53 1/4			Center Aft—Tee to Tee
31	5-72581-13	1	1 OD x .049 52SO	53 1/4			Center Aft—Tee to Tee
32	5-72581-9	1	1 OD x .049 52SO	54			Return Line LH Center to Aft
33	5-72581-4	1	5/8 OD x .042 52SO	60 3/8	AAF811-BT-10D AAF811-T-10CS	2 2	Aft Inter Tank Vent—Elbow to Tee RH
34	5-72581-4	1	5/8 OD x .042 52SO	60 3/8	AAF811-BT-10D AAF811-T-10CS	2 2	Aft Inter Tank Vent—Elbow to Tee LH
35	5-834519-2	1	1 OD x .049 52SO	22 7/8			Center Aft Tank, RH, to TEE, Left Side

KEY TO FIGURE 628B, LINES—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*No. Ftgs Req*	*Location*
36	5-834519-4	1	1 OD x .049 52SO	23 1/2			LH Aft Center Tank to Tee, Right Side
37	5-834519-12	1	1 OD x .049 52SO	59 3/4			Tee to Cross Aft Tank, LH
38	5-834519-14	1	1 OD x .049 52SO	54			Return Line, Aft Section, RH Cross to Hose
39	5-834519-14	1	1 OD x .049 52SO	54			Return Line, Aft Section, LH Cross to Hose
40	5-834519-10	1	1 OD x .049 52SO	56 1/4			Cross to Tee, Aft Tank, RH
41	5-834519-18	1	1 OD x .049 52SO	7-3/8			Aft Tank to Cross, RH
42	5-834519-18	1	1 OD x .049 52SO	7-3/8			Aft Tank to Cross, LH
43	5-834519-20	1	3/4 OD x .049 52SO	3-3/4	AAF811-BT-12D AAF811-T-12CS	2 2	Fwd. of Gate Valves, LH

ADDITIONAL LINES FOR 2—Tank and 4—Tank INSTALLATIONS

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*No. Ftgs Req*	*Location*
44	5-834519-20	1	3/4 OD x .049 52SO	3-3/4	AAF811-BT-12D AAF811-T-12CS	2 2	Fwd. of Gate Valves, RH
45	5139865-34	1	1 OD x .049 52SO	41-1/2			Located between two fwd. Tanks
46	5-72582-50	1	1 OD x .049 52SO	17-7/8			LH Forward Tank to Hose
47	5-72582-51	1	1 OD x .049 52SO	17-7/8			RH Fwd. Tank to Hose
48	5-72582-35	1	1 OD x .049 52SO	61			From Aft Cross to Center Hose
49	72704-6	1	1 OD x .049 52SO	21-1/2 & 3 (Weld Assem.)			Aft of Aft Cradle, LH
50	72704-7	1	1 OD x .049 52SO	21-1/2 & 3 (Weld Assem.)			Aft of Aft Cradle, RH
51	5139865-33	2	1 OD x .049 52SO	20-1/2			From Tank outlet to Cross LH & RH

FERRY FUEL SYSTEM FITTINGS
(C-47A and C-47B Airplanes)

KEY TO FIGURE 628B

Item	*Part No.*	*Part Name*	*Location*	*No. Req Per Apl*
1	No Fittings			
2	AAF811HT10	Union	At Upper End of Line	1
3	AAF811HT10	Union	At Upper End of Line	1
4	No Fittings			
5	AAF811HT12	Union	At Aft End of Line	1
6	AAF811HT12	Union	At Aft End of Line	1
7	No Fittings			
8	No Fittings			
9	AAF811HT10	Union	At Joining of Item 4 Line	1
10	AAF811HT10	Union	At Joining of Item 7 Line	1
11	AAF811HT10	Union	At Joint With Item 1 Line	1

KEY TO FIGURE 628B, FITTINGS—Continued

Item	*Part No.*	*Part Name*	*Location*	*No. Req Per Apl*
12	No Fittings			
13	No Fittings			
14	AAF811RT10	Tee	At Fwd End of Fwd Tank, RH	1
	AAF811CT10	Elbow	At Fwd End of Center Fwd Tank, RH	1
15	AAF811HT10	Union	At Joining with Item 8 Line	1
16	AAF811RT10	Tee	At Fwd End of Fwd Tank, LH	1
	AAF811CT-10	Elbow	At Fwd End of Center Fwd. Tank, LH	1
17	AN884-16-15	Hose	At LH Side, Fwd Valve Cluster	1
	Wittek FB-14	Clamp	At LH Side, Fwd Valve Cluster	2
18	AN884-16-15	Hose	At RH Side, Fwd Valve Cluster	1
	Wittek FB-14	Clamp	At RH Side, Fwd Valve Cluster	2
19	AAF850-16	Elbow	At Bottom Connection of Fwd. Tank, RH	1
	AAF895-87	Reducer	At Bottom Connection of Fwd. Tank, RH	1
	AN884-16-15	Hose	At Bottom Connection of Fwd. Tank, RH	1
	Wittek FB-14	Clamp	At Bottom Connection of Fwd. Tank, RH	2
20	AAF850-16	Elbow	At Bottom Connection of Fwd. Tank, LH	1
	AAF895-87	Reducer	At Bottom Connection of Fwd. Tank, LH	1
	AN884-16-15	Hose	At Bottom Connection of Fwd. Tank, LH	1
	Wittek FB-14	Clamp	At Bottom Connection of Fwd. Tank, LH	2
21	AN884-16-15	Hose	At Fwd End of Line, RH	1
	Wittek FB-14	Clamp	At Fwd End of Line, RH	2
22	AN884-16-15	Hose	At Fwd End of Line, RH	1
	Wittek FB-14	Clamp	At Fwd End of Line, RH	2
23	AN844-16-15	Hose	At Fwd End of Line, LH	1
	Wittek FB-14	Clamp	At Fwd End of Line, LH	2
24	AN884-16-15	Hose	At Fwd End of Line, LH	1
	Wittek FB-14	Clamp	At Fwd End of Line, LH	2
25	AAF811HT10	Union	At Joint with Item 15 Line, LH	1
26	AAF811HT10	Union	At Joint with Item 11 Line, RH	1
27	AAF895-87	Reducer	At Bottom Connection with Center Fwd Tank, RH	1
	AAF850-16	Elbow	At Bottom Connection with Center Fwd Tank, RH	1
	AN884-16-15	Hose	At Bottom Connection with Center Fwd Tank, RH	1
	Wittek FB-14	Clamp	At Bottom Connection with Center Fwd Tank, RH	2
	S4140744	Tee	At Connection with Center Feed Lines, LH	1
	Wittek FB-16	Clamp	At Connection with Center Feed Lines, LH	3
28	AAF895-87	Reducer	At Bottom Connection of Center Fwd Tank, LH	1
	AAF850-16	Elbow	At Bottom Connection of Center Fwd Tank, LH	1
	AN884-16-15	Hose	At Bottom Connection of Center Fwd Tank, LH	1
	Wittek FB-14	Clamp	At Bottom Connection of Center Fwd Tank, LH	2
	S4140744	Tee	At Connection with Center Feed Lines, RH	1
	Wittek FB-16	Clamp	At Connection with Center Feed Lines, RH	3
29	AN884-16-15	Hose	At Joint with Item 21 Line	1
	Wittek FB-14	Clamp	At Joint with Item 21 Line	2
30	No Fittings			
31	No Fittings			
32	AN884-16-15	Hose	At Joint with Item 24 Line	1
	Wittek FB-14	Clamp	At Joint with Item 24 Line	2
33	AAF811ST10	Tee	At Vent Connection of Center Aft Tank, RH	1
	AAF811CT10	Elbow	At Vent Connection of Aft Tank, RH	1
34	AAF811ST10	Tee	At Vent Connection of Center Aft Tank, LH	1
	AAF811CT10	Elbow	At Vent Connection of Aft Tank, LH	1
35	AAF895-87	Reducer	At Bottom Connection of Center Aft Tank, RH	1
	AAF850-16	Elbow	At Bottom Connection of Center Aft Tank, RH	1
	AN884-16-15	Hose	At Bottom Connection of Center Aft Tank, RH	1
	Wittek FB-14	Clamp	At Bottom Connection of Center Aft Tank, RH	2
	S4140744	Tee	At Connection with Center Lines, on Left Side	1
	Wittek FB-16	Clamp	At Connection with Center Lines, on Left Side	3

KEY TO FIGURE 628B, FITTINGS—Continued

Item	*Part No.*	*Part Name*	*Location*	*No. Req Per Apl*
36	AAF895-87	Reducer	At Bottom Connection of Center Aft Tank, LH	1
	AAF850-16	Elbow	At Bottom Connection of Center Aft Tank, LH	1
	AN884-16-15	Hose	At Bottom Connection of Center Aft Tank, LH	1
	Wittek FB-14	Clamp	At Bottom Connection of Center Aft Tank, LH	2
	S4140744	Tee	At Connection with Center Lines, on Right Side	1
	Wittek FB-16	Clamp	At Connection with Center Lines, on Right Side	3
37	No Fittings			
38	AN884-16-15	Hose	At Joint with Item 29 Line	1
	Wittek FB-14	Clamp	At Joint with Item 29 Line	2
39	AN884-16-15	Hose	At Joint with Item 32 Line	1
	Wittek FB-14	Clamp	At Joint with Item 32 Line	2
40	No Fittings			
41	AAF853-16	Elbow	At Bottom Connection of Aft Tank, RH	1
	AAF895-87	Reducer	At Bottom Connection of Aft Tank, RH	1
	AN884-16-15	Hose	At Bottom Connection of Aft Tank, RH	1
	Wittek FB-14	Clamp	At Bottom Connection of Aft Tank, RH	2
	S4140745	Cross	At Aft Valve, RH	1
	Wittek FB-16	Clamp	At Aft Valve, RH	4
42	AAF853-16	Elbow	At Bottom Connection of Aft Tank, LH	1
	AAF895-87	Reducer	At Bottom Connection of Aft Tank, LH	1
	AN884-16-15	Hose	At Bottom Connection of Aft Tank, LH	1
	Wittek FB-14	Clamp	At Bottom Connection of Aft Tank, LH	2
	S4140745	Cross	At Aft Valve, LH	1
	Wittek FB-16	Clamp	At Aft Valve, LH	4
43	AAF811ET12	Elbow	At Fwd End of Tube, LH	1
44	AAF811ET12	Elbow	At Fwd End of Tube, RH	1
45	AN884-16-15	Hose	At Fwd End of Line	1
	Wittek FB-14	Clamp	At Fwd End of Line	2
	S4140745	Cross	At Aft End of Line, two tank	1
	Wittek FB-14	Clamp	At Aft End of Line, two tank	4
46	AAF850-16	Elbow	At Tank Outlet	1
	AAF895-87	Reducer	At Tank Outlet	1
	AN884-16-15	Hose	At Tank Outlet	1
	Wittek FB-14	Clamp	At Tank Outlet	2
	AN884-16-15	Hose	At Inboard End of Line	1
	Wittek FB-14	Clamp	At Inboard End of Line	2
47	AAF850-16	Elbow	At Tank Outlet	1
	AAF895-87	Reducer	At Tank Outlet	1
	AN884-16-15	Hose	At Tank Outlet	1
	Wittek FB-14	Clamp	At Tank Outlet	2
	AN884-16-15	Hose	At Inboard End of Line	1
	Wittek FB-14	Clamp	At Inboard End of Line	2
48	AN884-16-15	Hose	At Fwd End of Line	1
	Wittek FB-14	Clamp	At Fwd End of Line	2
	S4140745	Cross	At Aft End of Line, Four Tank	1
	Wittek FB-14	Clamp	At Aft End of Line, Four Tank	4
49	AAF850-16	Elbow	At Tank Outlet	1
	AAF895-87	Reducer	At Tank Outlet	1
	AN884-16-15	Hose	At Tank Outlet	1
	Wittek FB-14	Clamp	At Tank Outlet	2
	AN884-16-15	Hose	At Junction of Lines from Fwd & Aft Tanks	1
	Wittek FB-14	Clamp	At Junction of Lines from Fwd & Aft Tanks	2

KEY TO FIGURE 628B, FITTINGS—Continued

Item	*Part No.*	*Part Name*	*Location*	*No. Req Per Ap*
50	AAF850-16	Elbow	At Tank Outlet	1
	AAF895-87	Reducer	At Tank Outlet	1
	AN884-16-15	Hose	At Tank Outlet	1
	Wittek FB-14	Clamp	At Tank Outlet	2
	AN884-16-15	Hose	At Junction of Lines from Fwd and Aft Tanks	1
	Wittek FB-14	Clamp	At Junction of Lines from Fwd and Aft Tanks	1
51	AAF850-16	Elbow	At Tank Outlet	2
	AAF895-87	Reducer	At Tank Outlet	2
	AN884-16-15	Hose	At Tank Outlet	2
	Wittek FB-14	Clamp	At Tank Outlet	4

KEY TO FIGURE 629

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
A	3115-1HT-4D	Parker Coupling	10
	11-1039-1-3D	Parker Lock Nut	10
B	AF811CT-4	Elbow	3
C		Spider	2
D	AN884-12-13	Hose	4
E	AN884-4-12	Hose	4
F	AN884-12-12	Hose	4
	AF835-12	Hose Nipple	1R-2L
	AF850-12	Hose Elbow	1R
G	AN884-12-12	Hose	9
H	AN884-4D	Elbow	2
I	AF37A3528	Restrictor Fitting	2
	AF811CT4	Elbow	2L-1R
	AN911-1D	Nipple	1L
	AN910-1D	Coupling	1L
	AF811-CT-45-4	Elbow	2
J	AF884-6-12	Hose	4
K	AF811CT-4	Elbow	2
	or		
	AF811CT-45°-4	Elbow	2
	AF811RT-4	Tee	2
L	AF811ST-4	Tee	2
M	AF811FT-4	Nipple	2
N	AF811-HT-6D	Union	2
O	AN842-4	Elbow	1
P	3117-4T-12D	Parker Coupling	2
	11-1039-1-14D	Parker Lock Nut	2
Q	AF811-ET-6	Elbow	2
R	3117-14T-12D	Parker Hose Connector	2
	11-1039-1-14D	Parker Lock Nut	2
S	3115-1HT-12D	Parker Coupling	4
	11-1039-1-19D	Parker Lock Nut	4
T	AF811-RT-6	Union	2
U	AF811-JT-12	Tee	2
V	AF811-HT-12D	Union	4

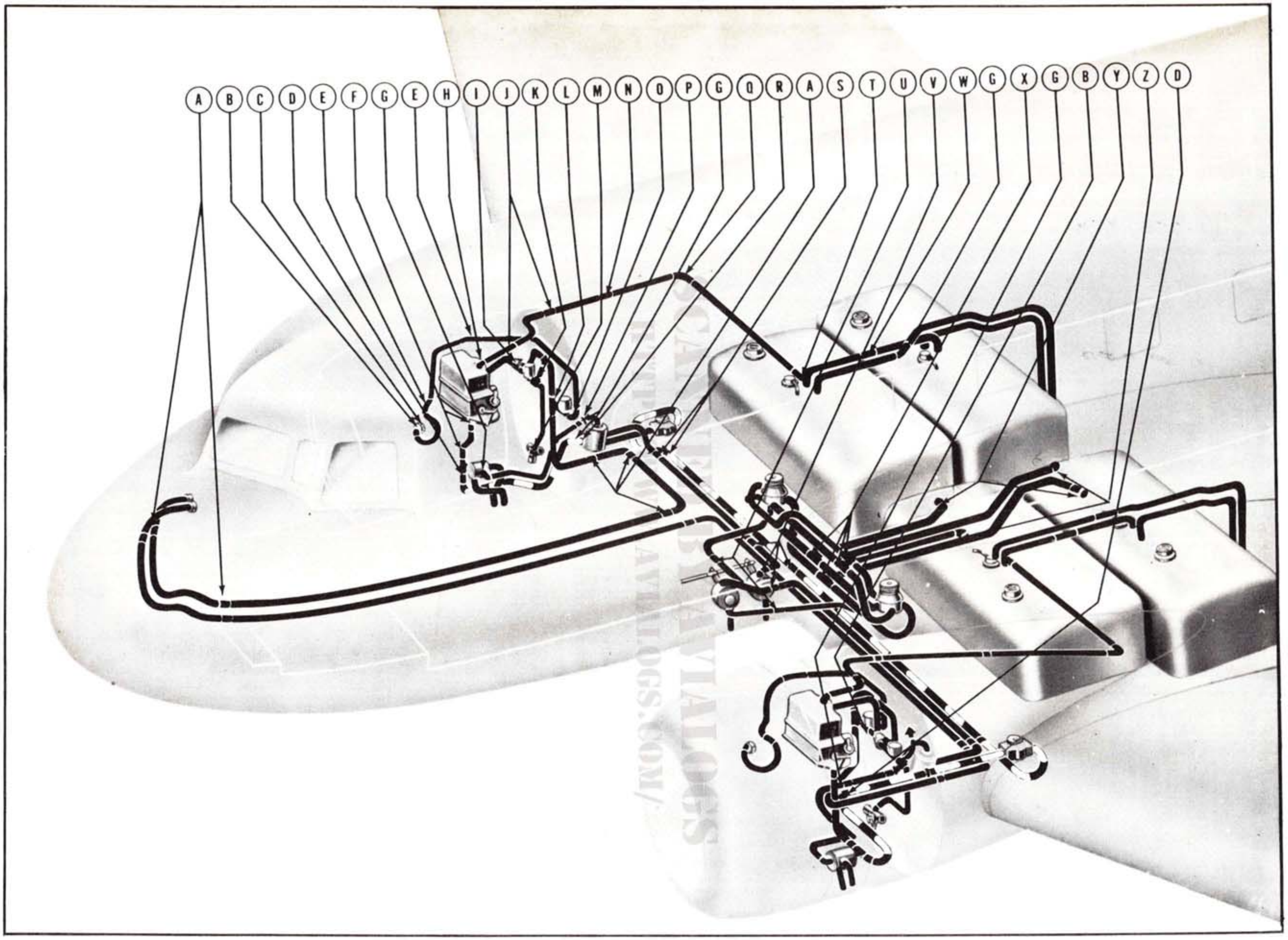

A
B
C
D
E
F
G
E
H
I
J
K
L
M
N
O
P
G
Q
R
A
S
T
U
V
W
G
X
G
B
Y
Z
D

Figure 629—Fuel System (Fittings)

KEY TO FIGURE 629—Continued

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
W	3706H-6-9	Weatherhead Hose	2
X	AF811-JT-12D	Tee	4
Y	AF811CT-45-12	Elbow	2
	AF895-87	Reducing Bushing	4
Z	No. 12CCT	Parker Elbow	2

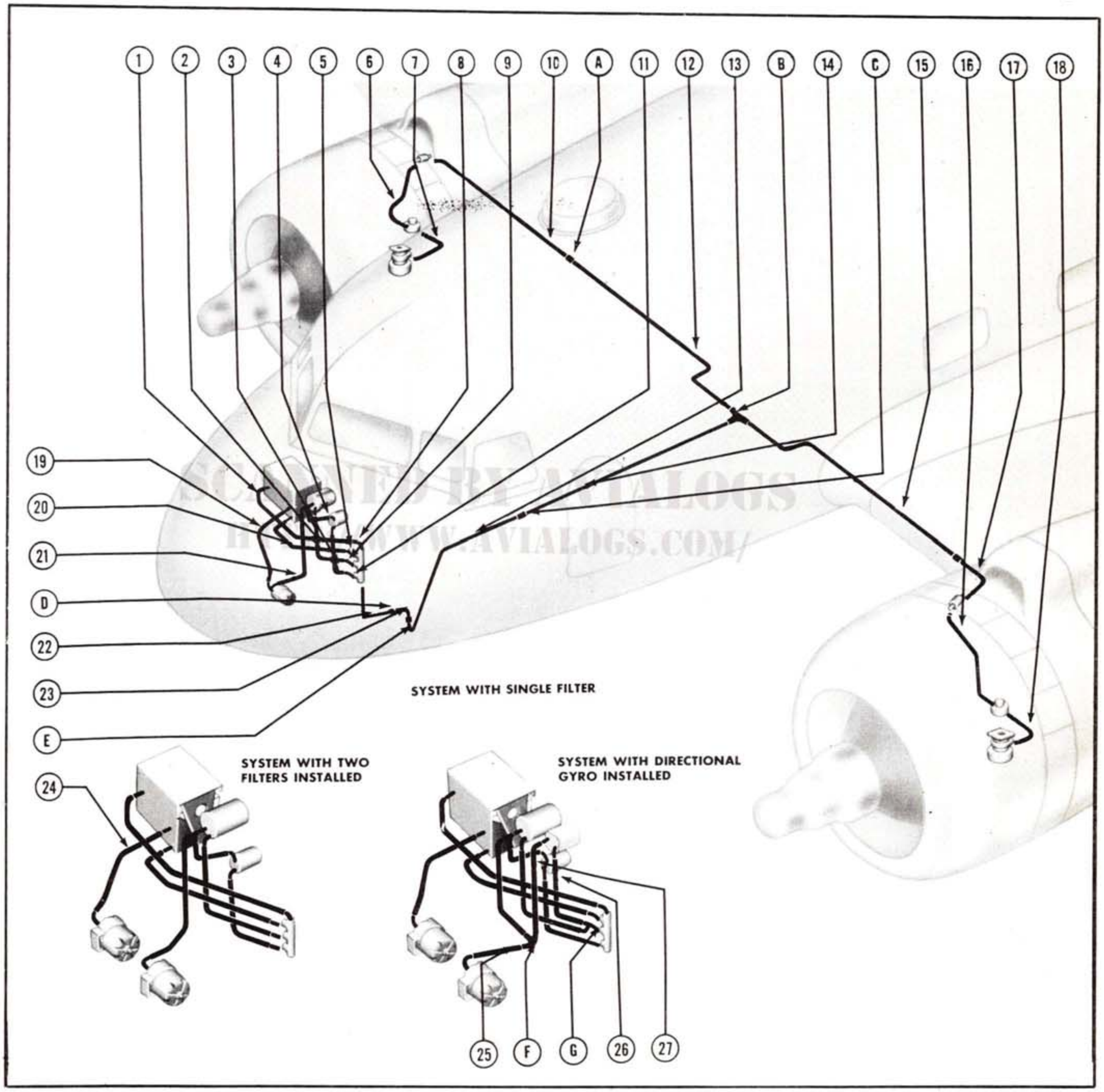

1
2
3
4
5
6
7
8
9
10
A
11
12
13
B
14
C
15
16
17
18
19
20
21
D
22
23
E
24
SYSTEM WITH SINGLE FILTER
SYSTEM WITH TWO FILTERS INSTALLED
SYSTEM WITH DIRECTIONAL GYRO INSTALLED
25
F
G
26
27

Figure 630—Vacuum System for Instruments and Automatic Pilot (Lines and Fittings) RED

(Douglas Dwgs. 5110560, 5202422, 5110549, 5141841, 5141410, and 5202419)

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs Per Line*
1	5112307-14	1	3/8 ID weatherhead hose	22-1/4		
2	5116836-10	1	3/8 ID hose	12-1/2		

KEY TO FIGURE 630—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs Per Line*
3	5116836-30	1	1/4 ID hose (C-47A and Early C-47B)	16		
	5116836-52	1	1/4 ID hose (Late C-47B)	14		
4	5116836-29	1	1/4 ID hose	13		
5	5112305-17	1	1/2 OD x .042-52SO	4-1/4		
6	5116702-3	1	1 OD x .049-52SO	23-1/2		
7	5116702-1	2	1 OD x .049-52SO	10		
8	5112305-18	1	1/2 OD x .042-52SO	7		
9	5112305-16	1	3/8 OD x .035-52SO	6		
10	5116700-6	1	7/8 OD x .049-52SO	40-1/2		
11	5112305-15	1	1/4 OD x .035-52SO	5		
12	5116700-5	1	7/8 OD x .049-52SO	76		
	or					
	5116700-8	1	7/8 OD x .049-52SO	80		
13	5112305-21	1	7/8 OD x .049-52SO	50		
14	5112305-22	1	7/8 OD x .049-52SO	93		
15	5116700-7	1	7/8 OD x .049-52SO	68-3/4		
	or					
	5116700-3	1	7/8 OD x .049-52SO	66-1/2		
16	5116702-2	1	1 OD x .049-52SO	26-1/2		
17	5116700-4	1	7/8 OD x .049-52SO	40		
18	5116702-1	1	1 OD x .049-52SO	10		
19	5112307-19	1	3/4 ID hose	14		
	5112306-18	1	3/4 OD x .049-52SO	6	AF811-BT12D	1
					AF811-T12CS	1
	5112306-23		3/4 OD x .049-52SO	9-1/2	AF811-BT12D	1
					1141112	1
20	5112307-15	1	1/2 ID hose	9		
21	5116836-21	1	1/2 ID hose	15		
22	5112305-19	1	7/8 OD x .049-52SO	27		
23	5112305-20	1	7/8 OD x .049-52SO	27		
24	5112307-23	1	3/4 ID weatherhead hose	45		
25	5112305-29	1	1/2 OD x .042-52SO	3-1/2	AF811-BT8D	1
					AF811-T8CS	1
	5112305-34	1	1/2 OD x .042-52SO	25	AF811-BT8D	1
					AF811-T8CS	1
26	5116836-46	1	3/8 ID hose	12-1/2		
27	5116836-43	1	1/2 ID hose	15		

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
A	3706-14-11	Weatherhead Hose	2
B	1118574	Line Coupling	1
C	3706-14-13	Weatherhead Hose	1
D	3706-14-13	Weatherhead Hose	1
E	3706-14-13	Weatherhead Hose	1
F	2205342	Wye	1
G	2205343	Wye	1

KEY TO FIGURE 631

(Douglas Dwgs. 5110560, 5141410, 5202422, and 5110514)

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs Per Line*
1	5116836-28	1	1/4 ID hose	10		
2	5112305-14	13	1/4 OD x .035-52SO	3-1/2	AF811-BT4D	1
					AF811-T4CS	1
3	*5116836-40	1	1/4 ID Weatherhead hose	31		
	**5116836-1	1	1/4 ID Weatherhead hose	19-1/2		

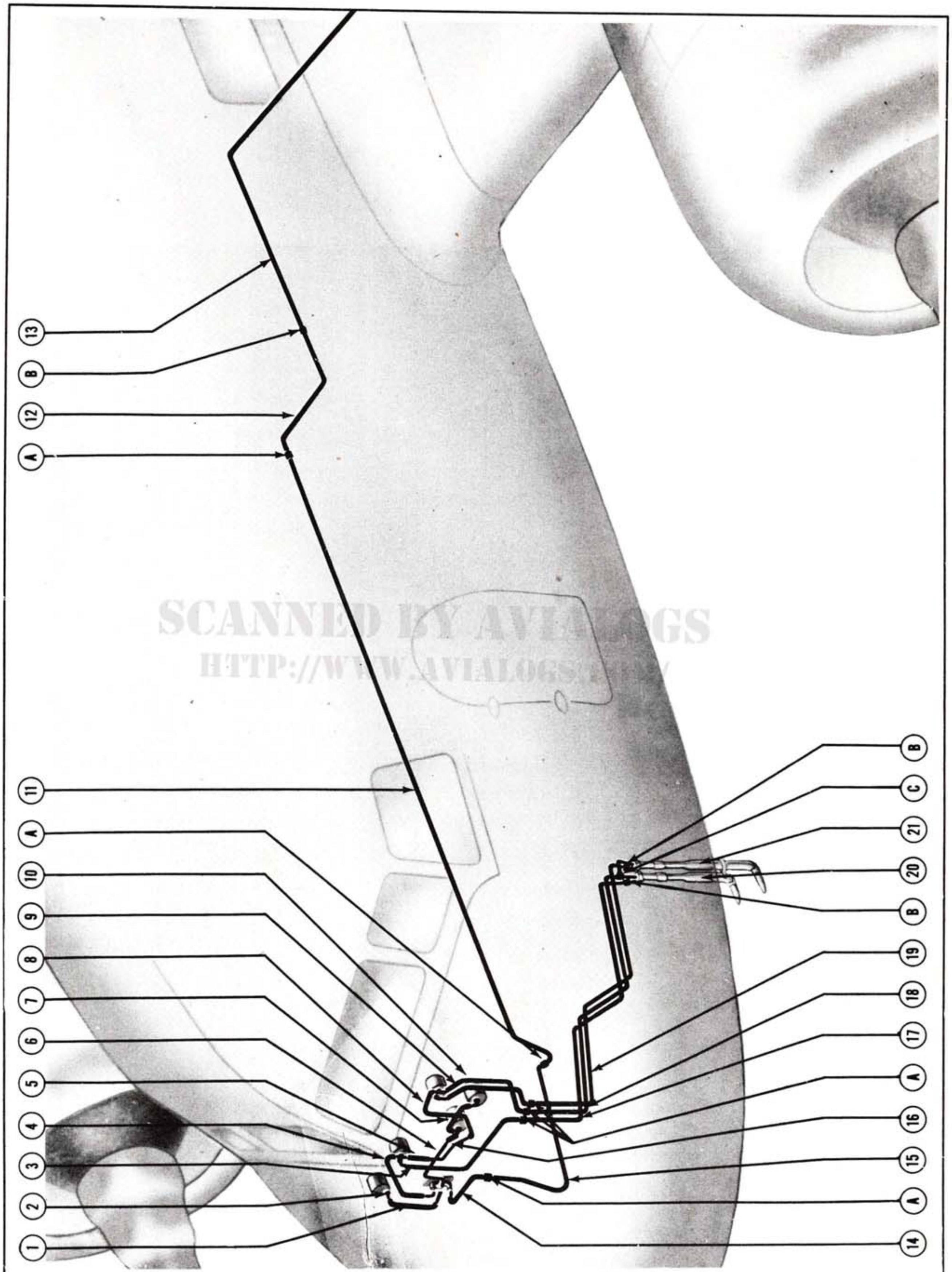

1
2
3
4
5
6
7
8
9
10
A
11
A
12
B
13
14
A
15
16
A
17
18
19
B
20
21
C
B

Figure 631—Pitot-Static Instrument System (Lines and Fittings)

KEY TO FIGURE 631—Continued

(Douglas Dwgs. 5110560, 5141410, 5202422, and 5110514)

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*
4	*5116836-25	1	1/4 ID hose	15		
	**5116836-3	1	1/4 ID hose	9-7/8		
5	5116836-26	1	1/4 ID hose	12		
6	5112305-31	1	1/4 OD x .035-52SO	20		
7	*5116836-27	1	1/4 ID hose	12		
	**5116836-8	2	1/4 ID hose	12-1/4		
8	5116836-22	1	1/4 ID hose	14-1/2		
9	*5116836-24	1	1/4 ID Weatherhead hose	15		
	**5116836-2	1	1/4 ID Weatherhead hose	15-1/2		
10	*5116836-23	1	1/4 ID Weatherhead hose	27		
	**5116836-6	1	1/4 ID Weatherhead hose	16		
11	5112305-9	1	1/4 OD x .035-52SO	150-1/4	AF811-BT4D	2
					AF811-T4CS	2
12	5116700-1	1	1/4 OD x .035-52SO	64-3/4	AF811-BT4D	2
					AF811-T4CS	2
13	5116700-2	1	1/4 OD x .035-52SO	123-3/4	AF811-BT4D	2
					AF811-T4CS	2
14	*5116836-38	1	1/4 ID hose	16-1/2		
	**5116836-5	1	1/4 ID hose	13-1/2		
15	5112305-8	1	1/4 OD x .035-52SO	47-1/4	AF811-BT4D	2
					AF811-T4CS	2
16	5112305-30	1	1/4 OD x .035-52SO	20		
17	5112305-2	1	1/4 OD x .035-52SO	51-1/2	AF811-BT4D	2
					AF811-T4CS	2
18	5112305-7	1	1/4 OD x .035-52SO	49-1/2	AF811-BT4D	2
					AF811-T4CS	2
19	5112305-4	1	1/4 OD x .035-52SO	53	AF811-BT4D	2
					AF811-T4CS	2
20	5112305-25	1	1/4 OD x .035-52SO	28	AF811-BT4D	1
				***33-3/4	AF811-T4CS	1
21	5112305-26	1	1/4 OD x .035-52SO	28-1/2	(Same as 19)	
				***33-1/4		
	5112305-27	1	1/4 OD x .035-52SO	34	(Same as 19)	
	5112305-28	1	1/4 OD x .035-52SO	38-1/4	(Same as 19)	

Item	*Part No.*	*Part Name*	*No. Req per Apl*
A	3115-1HT-4D	Parker Coupling	6
	11-1039-1-3D	Lock Nut	6
B	AF811HT4D	Union	3
C	AF8110T4D	Tee	1
	AF811CT4D	Elbow	1

*Late C-47A and early C-47B airplanes **Early C-47A and late C-47B airplanes ***Late C-47B airplanes

KEY TO FIGURE 632

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*
1	5112305-38	2	1/8 OD x .028 copper tubing	207	AN818-2D	2
					AN819-2D	2
2	5112316-7	1	1/8 OD x .028 copper tubing	180	AN818-2D	2
					AN819-2D	2
3	5112316-8	1	1/8 OD x .028 copper tubing	101	AN818-2D	2
					AN819-2D	2
4	5112314-38	2	1/4 OD x .035-52SO	11	AF811BT4D	2
					AF811T4D	2

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
A	AN856-2	Hose	2
B	AN832-2D	Union	2
C	AN815-2D	Union	2
D	2204719	Hose Assembly	2
E	AN5832-2	Filler Check Valve	2
F	AN6260-4-6-1/2	Hose Assembly	2
	148779-822-4-55	Restricted Elbow	2
	AN816-4D	Connector	2
G	3115-1HT-4D	Parker Bulkhead Coupling	2
	11-1039-1-3D	Lock Nut	2

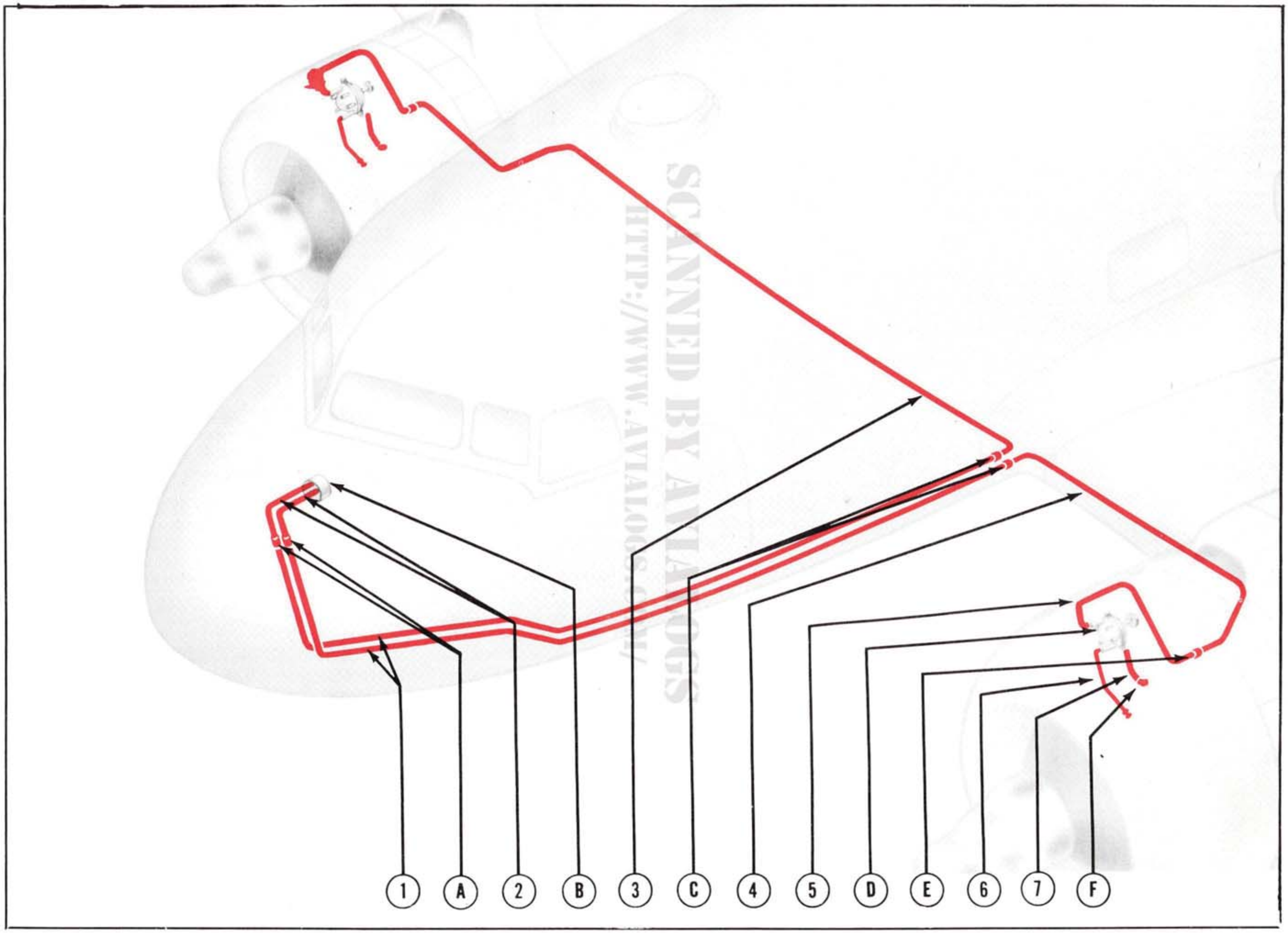

1
A
2
B
3
C
4
5
D
E
6
7
F

Figure 632—Remote Oil-Pressure Indicating System (Lines and Fittings)

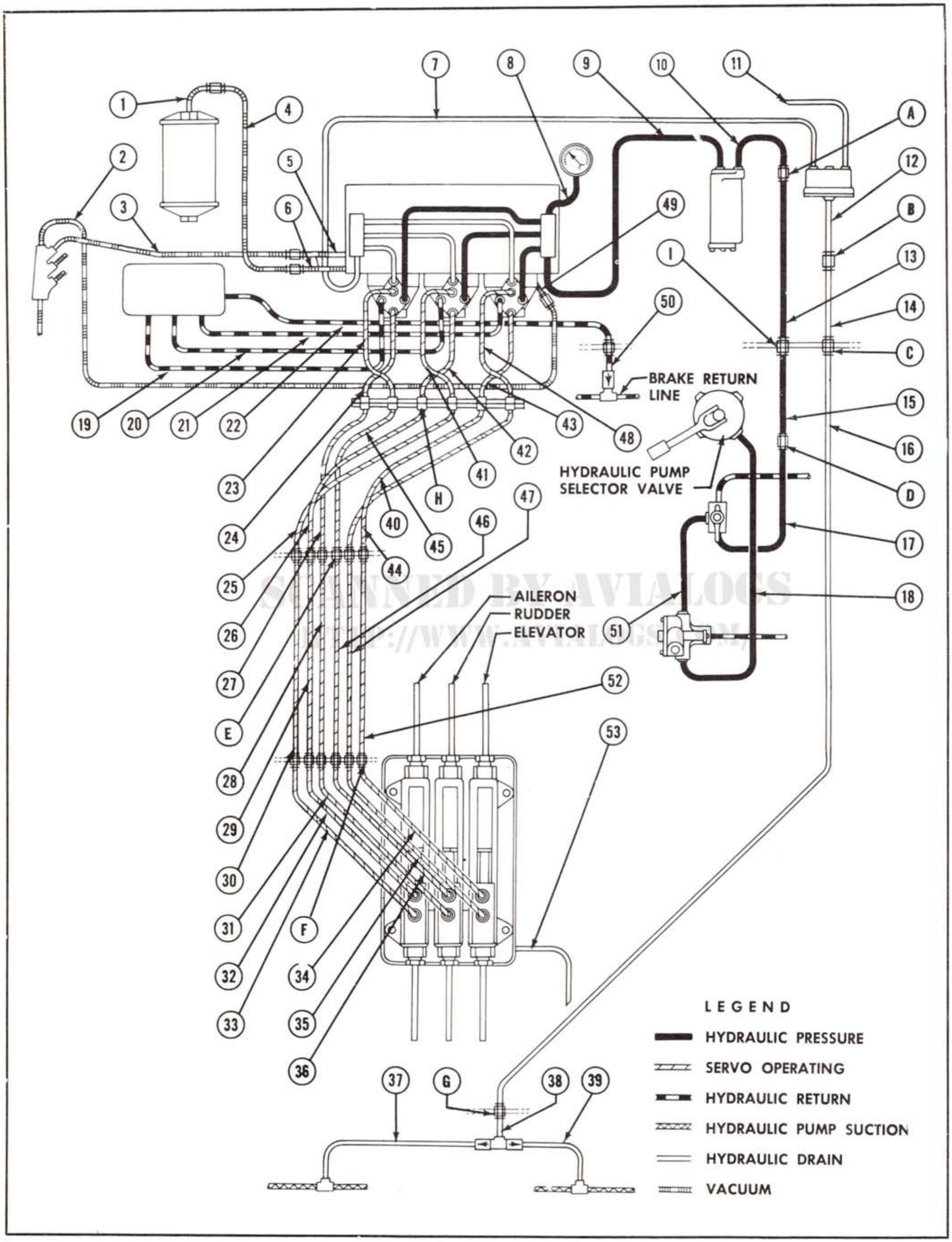

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
A
B
C
D
E
F
G
H
I
BRAKE RETURN LINE
HYDRAULIC PUMP SELECTOR VALVE
AILERON
RUDDER
ELEVATOR
LEGEND
HYDRAULIC PRESSURE
SERVO OPERATING
HYDRAULIC RETURN
HYDRAULIC PUMP SUCTION
HYDRAULIC DRAIN
VACUUM

Figure 633—Automatic Pilot System (Lines and Fittings)

KEY TO FIGURE 633

(Douglas Dwgs. 5110549, 5141841, 5202419)

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs Per Line*
1	5112306-18	1	3/4 OD x .049-52SO	6	AF811-BT12D	1
					AF811-T12CS	1
2	5112307-14	1	1/2 ID weatherhead hose assembly	17		
3	5112307-15	1	1/2 ID flex hose	9		
4	5112307-16	1	3/4 ID flex hose	17-1/2		
5	5112306-17	1	1/2 OD x .042-52SO	7	AF811-BT8D	1
					AF811-T8CS	1
6	5112306-23	1	3/4 OD x .049-52SO	9-1/2	AF811-BT12D	1
					114112	
7	5112307-13	1	3/8 ID weatherhead hose assembly	23-7/8		
8	5112307-12	1	3/16 ID weatherhead hose assembly	19-1/8		
9	5112307-11	1	1/2 ID weatherhead hose assembly	17		
10	5112306-22	1	1/2 OD x .042-52SO	24	AF811-BT6D	2
					AF811-T6CS	2
11	5112306-3	1	1/4 OD x .035-52SO	20	AF811-BT4D	1
					AF811-T4CS	1
12	5112306-21	1	3/8 OD x .035-52SO	14-3/4	AF811-BT6D	2
					AF811-T6CS	2
13	5112306-5	1	1/2 OD x .042-52SO	41	AF811-BT8D	2
					AF811-T8CS	2
14	5112306-1	1	3/8 OD x .035-52SO	44-1/2	AF811-BT6D	2
					AF811-T6CS	2
15	5112306-6	1	1/2 OD x .042-52SO	44	AF811-BT8D	2
					AF811-T8CS	2
16	5112306-2	1	3/8 OD x .035-52SO	144	AF811-BT6D	2
					AF811-T6CS	2
17	5112306-7	1	1/2 OD x .042-52SO	36-1/2	AF811-BT8D	2
					AF811-T6CS	2
18	5112306-9	1	1/2 OD x .042-52SO	20	AF811-BT8D	2
					AF811-T8CS	2
19	5112307-7	1	1/4 ID weatherhead hose assembly	18-1/4		
20	5112307-8	1	1/4 ID weatherhead hose assembly	19-7/8		
21	5112307-9	1	1/4 ID weatherhead hose assembly	20-1/2		
22	5112307-10	1	1/2 ID weatherhead hose assembly	16		
23	5112307-18	1	1/4 ID weatherhead hose assembly	11		
24	5112307-17	1	1/4 ID weatherhead hose assembly	8-3/4		
25	5112306-13	1	3/8 OD x .035-52SO	28	AF811-BT6D	2
					AF811-T6CS	2
26	5112306-12	1	3/8 OD x .035-52SO	26-1/2	AF811-BT6D	2
					AF811-T6CS	2
27	5112306-10	1	3/8 OD x .035-52SO	26	AF811-BT6D	2
					AF811-T6CS	2
28	5112306-16	1	3/8 OD x .035-52SO	74	AF811-BT6D	2
					AF811-T6CS	2
29	5112306-20	1	3/8 OD x .035-52SO	73-1/2	AF811-BT6D	2
					AF811-T6CS	2
30	5112306-16	1	3/8 OD x .035-52SO	74	AF811-BT6D	2
					AF811-T6CS	2
31	5112307-4	1	3/8 ID weatherhead hose assembly	25-1/4		
32	5112307-5	1	3/8 ID weatherhead hose assembly	20-3/4		
33	5112307-6	1	3/8 ID weatherhead hose assembly	22-1/2		
34	5112307-1	1	3/8 ID weatherhead hose assembly	22-1/4		
35	5112307-2	1	3/8 ID weatherhead hose assembly	26-1/8		
36	5112307-3	1	3/8 ID weatherhead hose assembly	23		
37	5116701-3	1	3/8 OD x .035-52SO	68	AF811-BT6D	2
					AF811-T6CS	2

KEY TO FIGURE 633—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*
38	5116701-1	1	3/8 OD x .035-52SO	7-1/2	AF811-BT6D	2
					AF811-T6CS	2
39	5116701-2	1	3/8 OD x .035-52SO	42	AF811-BT6D	2
					AF811-T6CS	2
40	5112306-15	1	3/8 OD x .035-52SO	28-1/2	AF811-BT6D	2
					AF811-T6CS	2
41	5112307-18	1	1/4 ID weatherhead hose assembly	11		
42	5112307-17	1	1/4 ID weatherhead hose assembly	8-3/4		
43	5112307-17	1	1/4 ID weatherhead hose assembly	8-3/4		
44	5112306-14	1	3/8 OD x .035-52SO	27	AF811BT6D	2
					AF811-T6CS	2
45	5112306-11	1	3/8 OD x .035-52SO	27-1/2	AF811-BT6D	2
					AF811-T6CS	2
46	5112306-20	1	3/8 OD x .035-52SO	73-1/2	AF811-BT6D	2
					AF811-T6CS	2
47	5112306-16	1	3/8 OD x .035-52SO	74	AF811-BT6D	2
					AF811-T6CS	2
48	5112307-18	1	1/4 ID weatherhead hose assembly	11		
49	5112306-17	1	1/2 OD x .042-52SO	7	AF811-BT8D	1
					AF811-T8CS	1
50	5112306-4	1	1/2 OD x .042-52SO	14	AF811-BT8D	2
					AF811-T8CS	2
51	5112306-8	1	1/2 OD x .042-52SO	12-1/2	AF811-BT8D	2
					AF811-T8CS	2
52	5112306-20	1	3/8 OD x .035-52SO	73-1/2	AF811-BT6D	2
					AF811-T6CS	2
53	5112306-19	1	1/4 OD x .035-52SO	5-1/2	AF811-BT4D	1
					AF811-T4CS	1

Item	*Part No.*	*Part Name*	*No. Req*
A	AF811HT-8D	Union	1
B	AF811HT-6D	Union	1
C	3115-1HT-6D	Parker Coupling	1
	11-1039-1-5D	Parker Nut	1
D	AF811HT-8D	Union	1
E	3115-1HT-6D	Parker Coupling	6
	11-1039-1-5D	Parker Nut	6
F	3115-1HT-6D	Parker Coupling	6
	11-1039-1-5D	Parker Nut	6
G	3115-1HT-6D	Parker Coupling	1
	11-1039-1-5D	Parker Nut	1
H	4-1740-5-6-4D-A	Parker Union	6
	11-1039-1-3D	Parker Lock Nut	6
I	3115-1HT-8D	Parker Coupling	1
	11-1039-1-10D	Parker Nut	1

KEY TO FIGURE 634—C-47 and C-47A Airplanes

(Douglas Dwg. Nos. 5110513, 5141942, 5110553, 5141943, 5110578, and 5204439)

Item	*Part No.*	*Part Name*	*No. Req*
A	4119659	Gage Assembly	1
	Consists of:		
	1119742	Gage	2
	4119659-4	Bracket	1
	1139060	Connector	2
	2119767	Ring	1
	2119766	Name Plate	1
	AF530-8-8	Screw	6
	1778-M-1	Tinnerman Nut	6

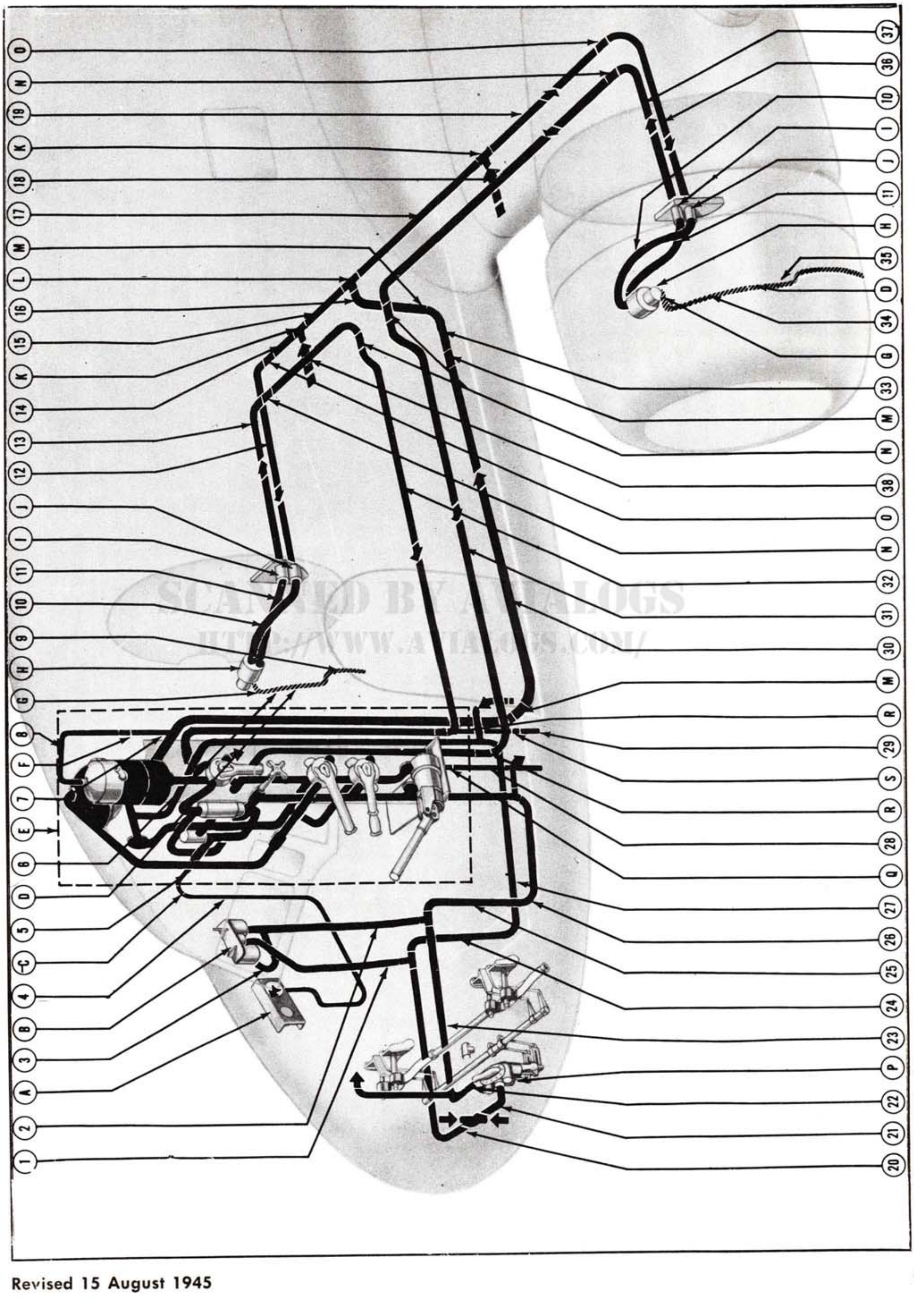

O
N
19
K
18
17
M
L
16
15
K
14
13
12
J
I
11
10
9
H
G
8
F
7
E
6
D
5
C
4
B
3
A
2
1
37
36
10
I
J
11
H
35
D
34
G
33
M
N
38
O
N
32
31
30
M
R
29
S
R
28
Q
27
26
25
24
23
P
22
21
20

Figure 634—Hydraulic Supply, Pressure, and Return System (Lines and Fittings)

KEY TO FIGURE 634—C-47 and C-47A Airplanes—Continued

Item	*Part No.*	*Part Name*	*No. Req*
B		Cowl Flap Control Valve (See figure 636)	(Ref)
C	3115-1ET-4D	Parker Elbow	1
D	3706-4-10	Weatherhead Hose	2
	2 F.B.	Wittek Clamp	4
E		For other parts within this area refer to figure 635	(Ref)
F	AN884-6-10	Hose	1
	GT-4	Wittek Clamp	2
G	AF851-4	Elbow	2
	3706-4-10	Weatherhead Hose	2
	2 F.B.	Wittek Clamp	4
H	214-U	Pesco Pump	2
	3/8 I.P. or	Street Elbow	4
	2203617	Pump Assembly	2
	Consists of:		
	I.P. 582 CA	Pesco Pump	2
	AN912-8	Bushing	4
	3/8 I.P.	Street Elbow	4
	or		
	2203932	Pump Assembly	2
	Consists of:		
	I.P. 582CA or I.P. 582K or I.P. 582CAC	Pesco Pump	2
	AN912-8	Bushing Reducer	2
	12CT-S	Parker Elbow	2
	8CT-S	Parker Elbow	2
I	2024792	Disconnect Valve (Pressure)	2
J	2024790	Disconnect Valve (Supply)	2
K	1116054	Tee	2
L	12-12-16JT-D	Parker Tee	1
M	AF811HT-16D	Union	3
N	3115-1HT-8D	Parker Bulkhead Union	4
	11-1039-1-10D	Lock Nut	4
O	3115-1HT-12D	Parker Bulkhead Union	2
	11-1039-1-19D	Lock Nut	2
P		Brake Control Valve	(Ref)
Q	4119778	Drip Pan	1
	AF884-4-10	Hose	1
	2F.B.	Wittek Clamp	2
R	AF811-8T-8D	Union	2
S	AF884-6-10	Hose	1

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5112589-19	(Ref)					Cowl flap return line
2	5112589-14	(Ref)					Cowl flap pressure line
3	5112589-16	(Ref)					Cowl flap pressure line (See figure 636)
4	5112589-56	1	1/4 OD x .032 52SO	56-1/4	AF811BT4D AF811T4CS	2 2	System pressure gage line—elbow to gage
5	5112589-30	1	1/4 OD x .032 52SO	25-1/2	AF811BT4D AF811T4CS	2 2	System pressure gage line—cross to elbow
6	2118611-4	1	1/4 OD x .035 52SO	8-1/2	None		RH pump drain line—pump elbow to hose
7	5112589-51	1	3/8 OD x .032 52SO	42-1/2	None		Reservoir vent line—hose to hose
8	5112589-42	1	3/8 OD x .032 52SO	37-1/2	AF811BT6D AF811T6CS	1 1	Reservoir vent line—reservoir to hose

KEY TO FIGURE 634—C-47 and C-47A Airplanes—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
9	2118611-5	1	1/4 OD x .035	20	None		RH pump drain line—hose to atmosphere
10	43D2474-12-210	2	Hose Assembly				Pump supply line—disconnect valve to pump
	1143338	2	Nut				
	1143339	2	Body				
	AN900-17 or	2	Gasket				
	4119137	2	Hose Assembly				
11	43D2474-8-210	2	Hose Assembly				Pump pressure line—disconnect valve to pump
	1143340	2	Nut				
	1143341	2	Body				
	AN900-12 or	2	Gasket				
	4119138	2	Hose Assembly				
12	5112588-24	1	3/4 OD x .049 52SO	35-1/2	AF811BT12D AF811T12CS	2	RH pump supply line—blkd union to disconnect valve
13	5112588-18	1	1/2 OD x .049 52SO	35	AF811BT8D AF811T8CS	2 2	RH pump pressure line—blkd union to disconnect valve
14	5112588-23	1	3/4 OD x .049 52SO	18-1/2	AF811BT12D AF811T12CS	2 2	RH pump supply line—tee to blkd union
15	5112588-22	1	3/4 OD x .049 52SO	40	AF811BT12D AF811T12CS	2 2	RH pump supply line—tee to tee
16	5112589-70	1	1 OD x .049 52SO	18-3/16	AF811BT16D AF811T16CS	2	Pump supply line—union to tee
17	5112588-19	1	3/4 OD x .049 52SO	65	AF811BT12D AF811T-12CS	2	LH pump supply line—tee to tee
18	5112588-15	1	1/2 OD x .049 52SO	117	AF811BT8D AF811T8CS	2 2	LH pump pressure line—blkd union to blkd union
19	5112588-20	1	3/4 OD x .049 52SO	46	AF811BT12D AF811T12CS	2	LH pump supply line—tee to blkd union
20	5112589-10	(Ref)					Brake return line (See figure 640)
21	5112589-2	(Ref)					Brake return line
22	5112589-4	(Ref)					Brake pressure line
23	5112589-3	(Ref)					Brake pressure line
24	5112589-11	(Ref)					Brake return line
25	5112589-2	(Ref)					Brake pressure line
26	5112589-54	(Ref)					Brake pressure line
27	5112589-12	(Ref)					Brake return line
28	5112589-48	1	1/4 OD x .035 52SO	23-1/2	None		Drip pan drain line
29	5112589-18	1	3/8 OD x .032 52SO	19-1/2	None		Reservoir vent line hose to atmosphere
30	5112589-46	1	1 OD x .049 52SO	88	AF811BT16D AF811T16CS	2 2	Pump supply line—union to union
31	5112589-36	1	1/2 OD x .049 52SO	118-1/2	AF811BT8D AF811T8CS	2 2	LH pump pressure line—union to blkd union
32	5112589-38	1	1/2 OD x .049 52SO	114-3/4	AF811BT8D AF811T8CS	2 2	RH pump pressure line—union to blkd union
33	5112589-69	1	1 OD x .049 52SO	34-3/4	AF811BT16D AF811T16CS	2 2	Pump supply line union to union
34	2118611-1	1	1/4 OD x .035 52SO	13-1/2	None		LH pump drain line—pump elbow to hose

KEY TO FIGURE 634—C-47 and C-47A Airplanes—Continued

Item	Part No.	No. Req	Size and Material	Lgth	Fittings	Ftgs per Line	Remarks
35	2118611-2	1	1/4 OD x .035 52SO	24	None		LH pump drain line hose to atmosphere
36	5112588-21	1	3/4 OD x .049 52SO	35-1/2	AF811BT12D AF811T12CS	2	LH pump supply line—blkd union to disconnect valve
37	5112588-16	1	1/2 OD x .049 52SO	35	AF811BT8D AF811T12CS	2 2	LH pump pressure line—blkd union to disconnect valve
38	5112588-17	1	1/2 OD x .049 52SO	62-3/4	AF811BT8D AF811T8CS	2 2	RH pump pressure line—blkd union to blkd union

* These lines not shown on this drawing. Refer to figure 374.

Item	Part No.	No. Req	Size and Material	Lgth	Fittings	Ftgs per Line	Remarks
*	5112589-40	1	3/8 OD x .032 52SO	11-1/2	AF811BT6D AF811T-6CS	2 2	Reservoir gage upper line—tee to top of gage
*	5112589-41	1	3/8 OD x .032 52SO	13	AF811BT6D AF811T6CS	2 2	Reservoir gage lower line—tee to bottom of gage

KEY TO FIGURE 634—C-47B Airplanes

Item	Part No.	Part Name	No. Req
A	4119659	Gage Assembly	1
	Consists of:		
	1119742	Gage	2
	4119659-4	Bracket	1
	1139060	Connector	2
	2119767	Ring	2
	2119766	Name Plate	1
	AAF530-8-8	Screw	6
	1778-M-1	Tinnerman Nut	6
B		Cowl Flap Control Valve (See figure 636)	(Ref)
D	AN884-4-12	Hose	2
	FB-2	Wittek Clamp	4
E		(For other parts within this area refer to figure 635A)	(Ref)
G	AN844-4	Elbow	2
	AN884-4-12	Hose	2
	FB-2	Wittek Clamp	4
H	2203932	Engine Driven Hydraulic Pump Assembly	2
	12-CT-S	Parker Elbow	2
	8-CT-S	Parker Elbow	2
I	S2024792	Disconnect Valve (press.)	2
	1118390	Locknut	2
	1139057-2	Washer	8
J	S2024790	Disconnect Valve (supply)	2
	1118391	Locknut	2
	1139057-4	Washer	8
K	1116054	Tee	2
L	12-12-16JT-D	Parker Tee	1
M	AAF811HT-16D	Union	3
N	3115-1HT-8D	Parker Blkd Union	4
	11-1039-1-10D	Parker Locknut	4
O	3115-1HT-12D	Parker Blkd Union	2
	11-1039-1-19D	Parker Locknut	2
P		Brake Control Valve	(Ref)
Q	4119778	Drip Pan	1
	AN884-4-12	Hose	1
	FB-2	Wittek Clamp	2
R	AAF811HT-8D	Union	2
S	AN884-6-12	Hose	1
	FB-4	Wittek Clamp	2

KEY TO FIGURE 634—C-47B Airplanes—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5204914-19	(Ref)					Cowl flap return line
2	5204914-15	(Ref)					Cowl flap pressure line
3	5204914-16	(Ref)					Cowl flap pressure line (See figure 636)
4	5204914-55	1	1/4 OD x .032 52SO	56-1/4	AAF811BT-4D AAF811T-4CS	2 2	System pressure gage blkd elbow to gage
6	5204912-3	1	1/4 OD x .035 52SO	8-1/2	None	None	RH engine pump to hose
9	5204912-4	1	1/4 OD x .035 52SO	20	None	None	RH engine hose to outside
10	AAF43D2474-12-214	2	Hose				Pump supply line—disconnect valve to pump
	1143338	2	Nut				
	1143339	2	Body				
	AN900-17	2	Gasket				
11	AAF43D2474-8-210	2	Hose				Pump pressure line—disconnect valve to pump
	1143340	2	Nut				
	1143341	2	Body				
	AN900-12	2	Gasket				
12	5204913-65	1	3/4 OD x .049 52SO	18	AAF811BT-12D AAF811T-12CS	1 1	Pump suction RH blkd union to shut-off valve
	AN884-12-16	1	Hose				
	D-32-175	1	Shut-off Valve Assembly (Pacific Aviation Inc)				
	5204913-66	1	3/4 OD x .049 52SO	18	AAF811BT-12D AAF811T-12CS	1 1	Pump suction RH shut-off valve to blkd union
	AN884-12-16	1	Hose				
13	5204913-18	1	1/2 OD x .049 52SO	35	AAF811BT-8D AAF811T-8CS	2 2	Pressure (RH pump) blkd union to union
14	5204913-23	1	3/4 OD x .049 52SO	18-1/2	AAF811BT-12D AAF811T-12CS	2 2	Pump suction RH tee to blkd union
15	5204913-22	1	3/4 OD x .049 52SO	40	AAF811BT-12D AAF811T-12CS	2 2	Pump suction RH tee to tee
16	5204914-67	1	1 OD x .049 52SO	21	AAF811BT-16D AAF811T-16CS	2 2	Pump suction union to tee
17	5204913-19	1	3/4 OD x .049 52SO	65	AAF811BT-12D AAF811T-12CS	2 2	Pump suction LH tee to tee
18	5204913-15	1	1/2 OD x .049 52SO	117	AAF811BT-8D AAF811T-8CS	2 2	Pressure (LH pump) blkd union to blkd union
19	5204913-20	1	3/4 OD x .049 52SO	46	AAF811BT-12D AAF811T-12CS	2 2	Pump suction LH tee to blkd union
20	5204914-10	(Ref)					Brake return line (See figure 640)
21	5204914-9	(Ref)					Brake return line
22	5204914-4	(Ref)					Brake pressure line
23	5204914-3	(Ref)					Brake pressure line
24	5204914-11	(Ref)					Brake return line
25	5204914-2	(Ref)					Brake pressure line
26	5204914-53	(Ref)					Brake pressure line
27	5204914-12	(Ref)					Brake return line
28	5204914-47	1	1/4 OD x .035 52SO	23-1/2	None		Hand pump drip pan drain
29	5204914-18	1	3/8 OD x .032 52SO	19-1/2	None		Reservoir vent hose to skin
30	5204914-46	1	1 OD x .049 52SO	89	AAF811BT-16D AAF811T-16CS	2 2	Pump suction union to union
31	5204914-36	1	1/2 OD x .049 52SO	120	AAF811BT-8D AAF811T-8CS	2 2	Pressure (LH pump) union to blkd union
32	5204914-38	1	1/2 OD x .049 52SO	115-1/2	AAF811BT-8D AAF811T-8CS	2 2	Pressure (RH pump) union to blkd union
33	5204914-66	1	1 OD x .049 52SO	24-1/2	AAF811BT-16D AAF811T-16CS	2 2	Pump suction union to union

KEY TO FIGURE 634—C-47B Airplanes—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
34	5204912-1	1	1/4 OD x .035 52SO	13-1/2	None		LH engine—pump to hose
35	5204912-2	1	1/4 OD x .035 52SO	24	None		LH engine—hose to outside
36	5204913-63	1	3/4 OD x .049 52SO	18	AAF811BT-12D AAF811T-12CS	1 1	Pump suction LH blkd union to shut-off valve
	AN884-12-16	1	Hose				
	D-32-176	1	Shut-off Valve Assembly (Pacific Aviation Inc)				
	5204913-64	1	3/4 OD x .049 52SO	18	AAF811BT-12D AAF811T-12CS	1 1	Pump suction LH shut-off valve to blkd union
	AN884-12-16	1	Hose				
37	5204913-16	1	1/2 OD x .049 52SO	35	AAF811BT-8D AAF811T-8CS	2 2	Pressure (LH pump) blkd union to blkd union
38	5204913-17	1	1/2 OD x .049 52SO	62-3/4	AAF811BT-8D AAF811T-8CS	2 2	Pressure (RH pump) blkd union to blkd union

KEY TO FIGURE 635

(Douglas Dwg. Nos. 5141943, 5110553, and 5118294)

Item	*Part No.*	*Part Name*	*No. Req*
A	6-6-8MMT-D	Parker Tee	1
B	8AGVDD-D	Parker Check Valve	1
	6-S	Parker Hex. Nipple	1
	8-FT-S	Parker Nipple	1
C	8-OT-S	Parker Tee (Open-End—Return from Automatic-Pilot System)	1
	8-CT-S	Parker Elbow	1
D	8-6-8MT-D	Parker Tee (Open-End—to Automatic-Pilot Press. Reg)	1
E	272778-1	System Pressure Relief Valve	1
F	8-8-4-6KOT-S	Parker Cross	1
G	8-6-6-MST-S	Parker Tee	1
H	8-8-6-6KSST	Parker Cross	1
I	8GVFT	Parker LH Check Valve	1
J	AF811-OT8D	Tee	1
K	8-FT-S	Parker Nipple	1
L	8-GVFF	Parker Check Valve	1
M	8GVHT	Parker Check Valve	1
N	6FT-S	Parker Fitting	1
O	8-6-8-6 KMOT	Parker Cross	1
P	404-LGT-6	Parker Check Valve	1
Q	2119018	Wing Flap Relief Valve Assembly	1
R	1/4 I.P.	Street Steel Elbow	1
S	8-4-8JT-S	Parker Tee	1
T	8-6-8JT-S	Parker Tee	1
U	8CT-S	Parker Elbow	1
V	5133124	Pressure Accumulator (See figure 367)	1
W	4116932	Hydraulic Fluid Reservoir	1
X	1119739	Elbow	1
Y	16FT-S	Parker Nipple	1
Z	8FTS	Parker Nipple	1
AA	8-6-8RT-S	Parker Tee	1
BB	4118979	Engine Pump Selector Valve	1
CC		Supply to Automatic Pilot Pressure Regulator Valve	(Ref)
DD	4005434	Pressure Regulator	1
EE	2118951-3	Handle Assembly	1
FF	2130323	Hand Pump to Pressure Accumulator Shut-off Valve	1

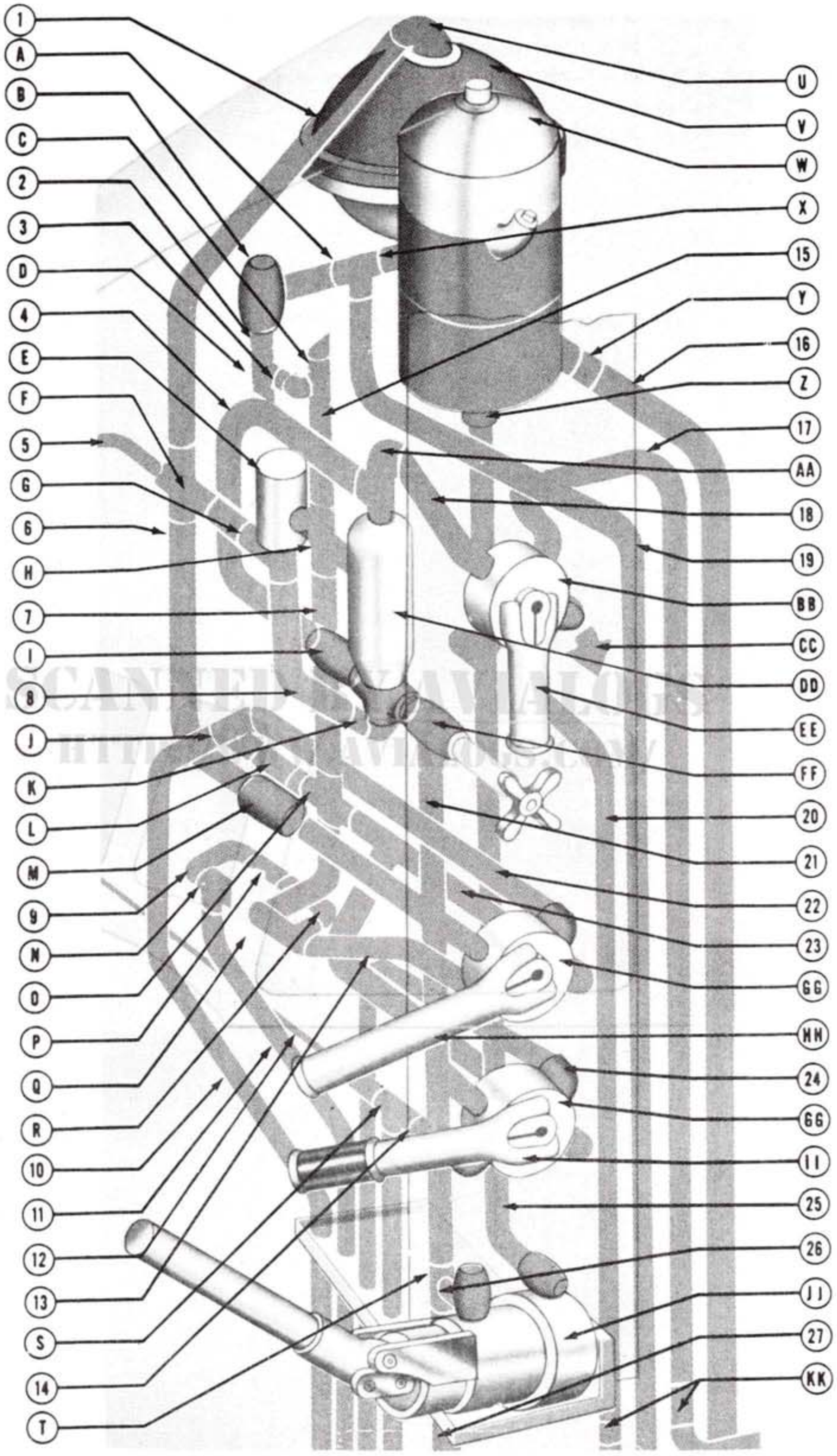

1
A
B
C
2
3
D
4
E
F
5
G
6
H
7
I
8
J
K
L
M
9
N
O
P
Q
R
10
11
12
13
S
14
T
U
V
W
X
15
Y
16
Z
17
AA
18
19
BB
CC
DD
EE
FF
20
21
22
23
GG
HH
24
GG
II
25
26
JJ
27
KK

Figure 635—Detail of Hydraulic Control Panel Supply, Pressure, and Return System (For C-47B, see Figure 635A)

KEY TO FIGURE 635—Continued

Item	*Part No.*	*Part Name*	*No. Req Per Assem*
GG	4118984	Wing Flap and Landing-Gear Control Valves	2
HH	2118951-2	Handle Assembly	1
II	2118951-1	Handle Assembly	1
JJ	4118980	Hydraulic Hand Pump	1
KK	AF811HT-8D	Union	2

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5112589-71	1	1/2 OD x .049 52SO	41-1/2	AF811BT-8D AF811T-8CS	2 2	Pressure line—accumulator elbow to cross
2	5112589-17	1	1/2 OD x .042 52SO	10	AF811BT-8D AF811T-8CS	2 2	Return line—tee to check valve nipple
3	5112589-44	1	1/2 OD x .042 52SO	8	AF811BT-8D AF811T-8CS	2 2	Return line—elbow to tee
4	5118162-2	1	1/2 OD x .042 52SO	16-1/2	AF811BT-8D AF811T-8CS	2 2	Pressure line—check valve to tee in regulator
5	5112589-30	(Ref)	1/4 OD x .032 52SO	25-1/2	AF811BT-4D AF811T-4CS	2 2	System pressure gage line—cross to blkd elbow (See figure 634)
6	5118162-12	1	1/2 OD x .065 52SO	10-1/2	AF811BT-8D AF811T-8CS	2 2	Pressure line—cross to check valve
7	5118162-7	1	1/2 OD x .042 52SO	10-1/2	AF811BT-8D AF811T-8CS	2 2	Return line—cross to cross
8	5118162-3	1	1/2 OD x .042 52SO	12	AF811BT-8D AF811T-8CS	2 2	Pressure relief line—regulator to tee
9	5118162-11	1	3/8 OD x .035 52SO	11	AF811BT-6D AF811T-6CS	2 2	Bypass line—check valve to tee
10	5112589-49	(Ref)	1/2 OD x .049 52SO	33	AF811-8T-8D AF811T-8CS	2 2	Wing flap up line tee to union (See figure 637)
11	5112589-52	1	1/2 OD x .049 52SO	26-3/4	AF811BT-8D AF811T-8CS	2 2	Wing flap down line—check valve to union
12	5112589-29	(Ref)	1/4 OD x .032 52SO	23-1/2	AF811BT-4D AF811T-4CS	2 2	Landing-gear down gage line tee to blkd elbow (See figure 639)
13	5118162-9	(Ref)	1/2 OD x .042 52SO	5-1/4	AF811BT-8D AF811T-8CS	2 2	Wing flap down line—control valve to tee (See figure 637)
14	5112589-31	1	1/2 OD x .049 52SO	6-1/4	AF811BT-8D AF811T-8CS	2 2	Landing-gear down line—control valve to tee
15	5118162-6	1	1/2 OD x .42 52SO	2	AF811BT-8D AF811T-8CS	2 2	Return line—cross to tee
16	5112589-45	1	1 OD x .049 52SO	61-1/2	AF811BT-16D AF811T-16CS	2 2	Engine pump supply line—reservoir to union
17	5112589-37	1	1/2 OD x .049 52SO	55-1/2	AF811BT-8D AF811T-8CS	2 2	RH engine pump pressure line—selector valve to union
18	5118162-1	1	1/2 OD x .042 52SO	8-1/2	AF811BT-8D AF811T-8CS	2 2	Pressure line—regulator to pump selector valve
19	5112589-13 or	1	1/2 OD x .042 52SO	59	AF811BT-8D AF811T-8CS	2 2	Brake return line—union to tee at reservoir
	5112589-68	1	1/2 OD x .042 52SO	58	AF811BT-8D AF811T-8CS	2 2	Brake return line—tee to tee on reservoir
20	5112589-35	1	1/2 OD x .049 52SO	47-1/2	AF811BT-8D AF811T-8CS	2 2	LH engine pump pressure line—selector valve to union
21	3118978	1					Control panel pressure manifold assembly

KEY TO FIGURE 635—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
22	5118162-8	1	1/2 OD x .042 52SO	17-3/4	AF811BT-8D AF811T-8CS	2 2	Wing flap up line control valve to tee
23	3118977	1					Control panel return manifold assembly
24	5112589-33	1	1/2 OD x .049 52SO	24	AF811BT-8D AF811T-8CS	2 2	Landing-gear up line—control valve to union (See figure 639)
25	5112589-43	1	1/2 OD x .049 52SO	42	AF811BT-8D AF811T-8CS	2 2	Hand pump supply line —hand pump to reservoir
26	5118162-10	1	1/2 OD x .065 52SO	10-1/2	AF811BT-8D AF811T-8CS	2 2	Hand pump pressure line—check valve to tee
27	5112589-1 or 5112589-67	(Ref)					Brake pressure line— —tee on control panel to union or tee (See figure 642)

KEY TO FIGURE 635A

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5204914-42	1	1/2 OD x .032 52SO	37-1/2	AAF811BT-6D AAF811T-6CS	2 2	Reservoir vent to hose
2	5204914-40	1	3/8 OD x .032 52SO	11-1/2	AAF811BT-6D AAF811T-6CS	2 2	Reservoir gage—Tee to top of gage
3	5118162-5	1	1/2 OD x .042 52SO	14	AAF811T-8CS AAF811BT-8D	2 2	By pass line
4	5204914-41	1	3/8 OD x .032 52SO	13	AAF811BT-6D AAF811T-6CS	2 2	Reservoir gage—Tee to bottom of gage
5	5204914-35	1	1/2 OD x .049 52SO	47-1/2	AAF811BT-8D AAF811T-8CS	2 2	Pressure (LH pump) selector valve to union
6	5112306-27	1	1/2 OD x .042 52SO	14	AAF811BT-8D AAF811T-8CS	2 2	Autopilot oil pressure reg. to gyropilot shut-off valve
7	5118162-20	1	1/2 OD x .042 52SO	10	AAF811T-8CS AAF811BT-8D	2 2	Return line
8	5118162-9	1	1/2 OD x .042 52SO	5	AAF811T-8CS AAF811BT-8D	2 2	Flap down line—Flap valve to tee
9	5204914-50	1	3/8 OD x .032 52SO	42-1/2	no fittings		Reservoir to vent hose
10	5204914-33	1	1/2 OD x .049 52SO	24	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up valve to union
11	5204914-31	1	1/2 OD x .049 52SO	6	AAF811BT-8D AAF811T-8CS	2 2	LDG gear down-valve to tee
12	5118162-10	1	1/2 OD x .042 52SO	3	AAF811T-8CS AAF811BT-8D	2 2	Pumpline—check valve to tee
13	5204914-83	1	1/2 OD x .042 52SO	58-1/2	AAF811BT-8D AAF811T-8CS	2 2	Hand pump suction to reservoir tee
14	5204914-32	1	1/2 OD x .049 52SO	17	AAF811BT-8D AAF811T-8CS	2 2	LDG gear down—tee to union
15	5204914-82	1	1/2 OD x .042 52SO	5-1/4	AAF811BT-8D AAF811T-8CS	2 2	Automatic pilot return—tee to tee on reservoir
16	5204914-91	1	1/2 OD x .049 52SO	24-1/2	AAF811BT-8D AAF811T-8CS	2 2	Pressure tank to union
17	5204914-78	1	1/4 OD x .035 52SO	38	AAF811BT-4D AAF811T-4CS	2 2	Regulator drain—Regulator to reservoir
18	5204914-45	1	1 OD x .049 52SO	61-1/2	AAF811BT-16D AAF811T-16CS	2 2	Pump suction—Reservoir to union
19	5118162-4	1	1/2 OD x .042 52SO	7-1/2	AAF811T-8CS AAF811BT-8D	2 2	Return line

KEY TO FIGURE 635A—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
20	5112306-29	1	1/2 OD x .042 52SO	12	AAF811BT-8D AAF811T-8CS	2 2	Automatic pilot oil press. reg valve to tee
21	5204914-92	1	1/2 OD x .049 52SO	44-1/2	AAF811BT-8D AAF811T-8CS	2 2	Pressure tank union to cross
22	5112306-28	1	1/2 OD x .042 52SO	21	AAF811BT-8D AAF811T-8CS	2 2	Cross to selector valve
23	5118162-15	1	1/2 OD x .042 52SO	36	AAF811T-8CS AAF811BT-8D	2 2	Pressure line filter to selector valve
24	5118162-17	1	1/2 OD x .042 52SO	13	AAF811T-8CS AAF811BT-8D	2 2	Pressure line—pressure regulator to filter
25	5204914-30	1	1/4 OD x .032 52SO	22	AAF811BT-4D AAF811T-4CS	2 2	System pressure gage elbow on panel to bulkhead elbow
26	5118162-8	1	1/2 OD x .042 52SO	15-3/4	AAF811T-8CS AAF811BT-8D	2 2	Flap up—flap valve to tee
27	5118162-18	1	1/2 OD x .065 52SO	9	AAF811T-8CS AAF811BT-8D	2 2	Pressure line—cross to Parker check valve
28	5118162-19	1	1/2 OD x .042 52SO	9-1/2	AAF811T-8CS AAF811BT-8D	2 2	Pressure line from pressure relief valve to Parker tee
29	5118162-21	1	3/8 OD x .035 52SO	5	AAF811T-6CS AAF811BT-6D	2 2	Check valve to elbow
30	5204914-29	1	1/4 OD x .032 52SO	23-1/2	AAF811BT-4D AAF811T-4CS	2 2	LDG gear down—gage tee to blkd elbow
31	5204914-48	1	1/2 OD x .049 52SO	33	AAF811BT-8D AAF811T-8CS	2 2	Wing flap up—tee to union
32	5204914-51	1	1/2 OD x .049 52SO	26-3/4	AAF811BT-8D AAF811T-8CS	2 2	Wing flap down, tee to check valve
33	5204914-37	1	1/2 OD x .049 52SO	55-1/2	AAF811BT-8D AAF811T-8CS	2 2	Pressure (RH pump) Selector valve to union
34	5204914-81	1	1/2 OD x .049 52SO	58-5/8	AAF811BT-8D AAF811T-8CS	2 2	Brake return union to automatic pilot return tee

(NOTE: 5118162-11 on some late C-47B)

Item	*Part No.*	*Part Name*	*No. Req*
A	4118608	Reservoir	1
B	6-RT-S	Parker Tee	1
C	6-RT-S	Parker Tee	1
D	1119739	Special Elbow	1
E	16FT-S	Parker Nipple	1
F	8-6-4RT-S	Parker Tee	1
G	AAF895-82	Reducer	1
H	4-4-6MRT-S	Parker Tee	1
I	AAF895-71	Plug	1
J	AAF995-C40-8	Lockwire	1
K	8-CT-S	Parker Elbow	1
L	8-OT-S	Parker Tee	1
M	AAF811-CT-4NS	Elbow	1
N	8-8-6-6KSST	Parker Cross	1
O	4209830	Valve Assembly (Pump Selector)	1
P	AAF811-CT8-NS	Elbow	1
Q	4118981	Gyro Pilot Shut-off Valve Assembly	1
R	404906-0-1	Pressure Regulator (Bendix)	1
Note: 404906 (Bendix) on some late C-47B Airplanes			
S	8-6-8ROTNS	Parker Tee	1
T	AN912-4	Bushing	1
U	2130323	Hand Pump Shut-off Valve	1
V	8-6-8-6KMOT	Parker Cross	1
W	3118978	Pressure Manifold	1
X	3118977	Return Manifold	
Y	4209829	Valve Assembly (Landing Gear)	1
Z	AN914-2	Street Elbow	1

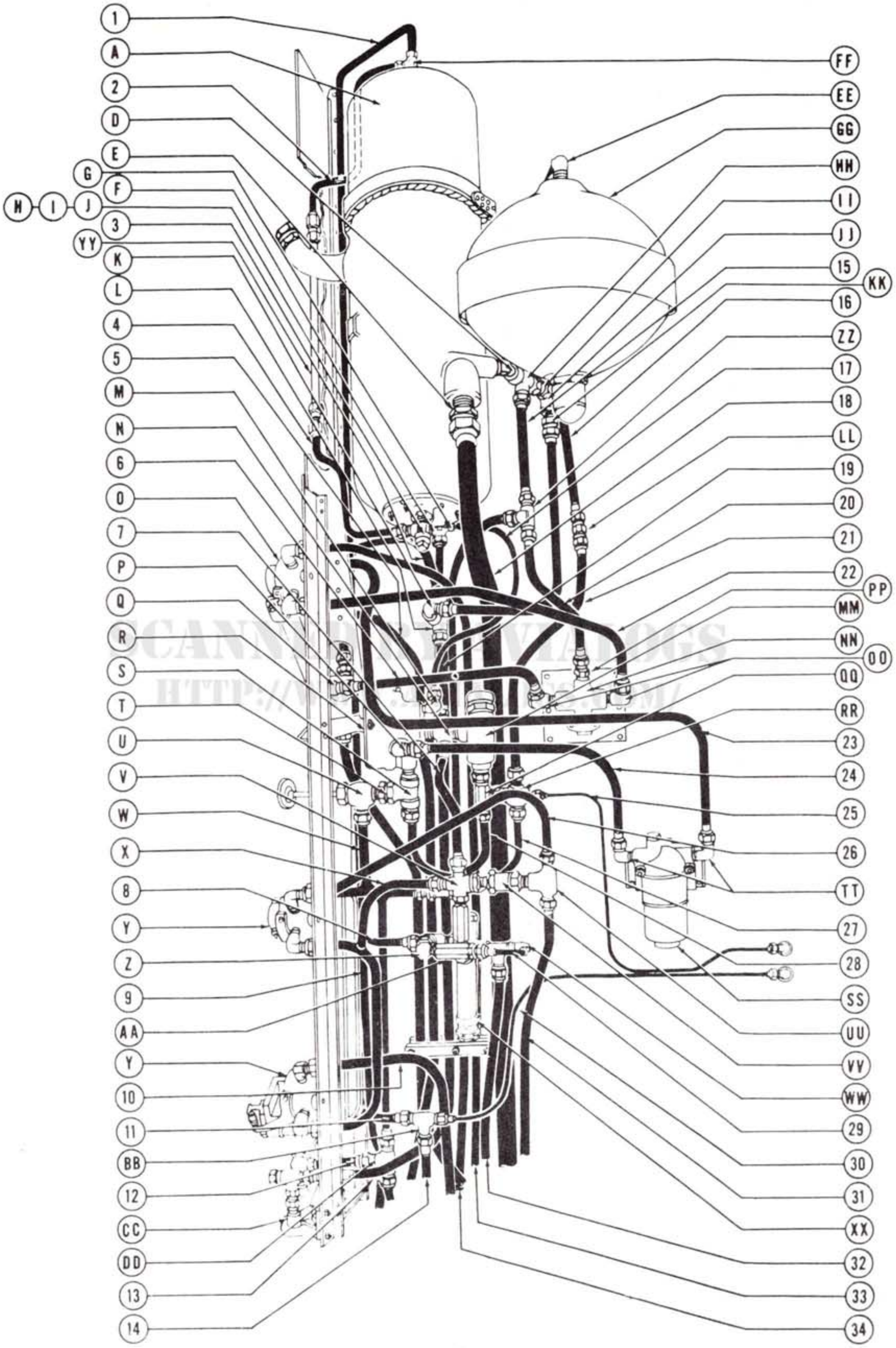

1
A
2
D
E
G
F
H
I
J
3
YY
K
L
4
5
M
N
6
O
7
P
Q
R
S
T
U
V
W
X
8
Y
Z
9
AA
Y
10
11
BB
12
CC
DD
13
14
FF
EE
GG
HH
II
JJ
15
KK
16
ZZ
17
18
LL
19
20
21
22
PP
MM
NN
OO
QQ
RR
23
24
25
26
TT
27
28
SS
UU
VV
WW
29
30
31
XX
32
33
34

Figure 635A—Hydraulic Control Panel Supply, Pressure, and Return System (Lines and Fittings) C-47B Airplanes

KEY TO FIGURE 635A—Continued

Item	*Part No.*	*Part Name*	*No. Req*
AA	404-LGT-6	Parker Check Valve	1
BB	8-4-8JT-S	Parker Tee	1
CC	5209981	Hand Pump Assembly	1
DD	8-6-8JT-S	Parker Tee	1
Note: 8-6-8JT-NS Parker Tee on some late C-47B Airplanes.			
EE	8CT-S	Parker Elbow	1
FF	8GVFT	Parker Check valve	1
FF	6-RT-S	Parker Tee	1
GG	5133124	Accumulator	1
HH	6-6-8MMT-D	Parker Tee	1
II	6-S	Parker Hex Nipple	1
JJ	8AGVDD-D	Parker Check Valve	1
KK	8FT-S	Parker Nipple	1
LL	AAF811-HT-8D	Union	1
MM	S-272778-1	Relief Valve	1
NN	B-3120	Autopilot Oil Pressure Regulator	1
OO	AAF811-CT-8D	Elbow	2
PP	AAF811-FT-8D	Nipple	1
QQ	8-6-6MST-S	Parker Tee	1
RR	8-8-4-6KOT-S	Parker Cross	1
SS	31128	Purolator Filter—Type PR306-2	1
TT	AAF811-CT-8NS	Elbow	2
UU	AAF811-OT-8D	Tee	1
VV	475-FF-8	Parker Check Valve	1
WW	AAF811-CT-6NS	Elbow	1
Note: 6FT-S Parker Nipple on some late C-47B Airplanes.			
XX	2119018	Relief Valve Assembly (Wing Flap)	1
YY	1119802	Gage Assembly	1
ZZ	AAF811-JT-8D	Tee	1

KEY TO FIGURE 636—C-47 and C-47A Airplanes

(Douglas Dwg. Nos. 5110553, 5141943, 5110513, 5141942, 5110578, 5113759, and 5141800)

Item	*Part No.*	*Part Name*	*No. Req*
A	AF811CT-4	Elbow (With 4143736 Valve Assembly)	1
	AN901-4A	Gasket	1
	or		
	AN815-4D	Connector (With Adel Valve Assembly)	1
	AN901-4A	Gasket	1
B	4143736	Cowl Flap Control Valve and Bracket Assembly (figure 422)	1
	Attached by:		
	AN3-10A	Bolt	1
	AN3-6A	Bolt	2
	AF365-1032	Nut	3
	or		
	D9726	Cowl Flap Control Valve Assembly (Adel)	1
C	1141672	Tee Assembly	1
	Consists of:		
	4-JT-S	Parker Tee	1
	1141671	Plug	1
D		(Refer to figure 635 for parts within this area)	
E	2116312	Cowl Flap Actuating Cylinder	2
	or		
	2000	Cowl Flap Actuating Cylinder (Precision Products)	2
F	4CT-S	Parker Elbow	4
G	3115-1HT-4D	Parker Coupling	16
	11-1039-1-3D	Lock Nut	16
H	8-8-4JTD	Parker Tee	(Ref)
J	6-6-4JTD	Parker Tee	(Ref)

KEY TO FIGURE 636—C-47 and C-47A Airplanes—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5112589-19	1	1/4 OD x .032 52SO	48	AF811BT-4D AF811T-4CS	2 2	Cowl flap return line—valve to tee in brake return line
2	5112589-23	1	1/4 OD x .032 52SO	48-1/4	AF811BT-4D AF811T-4CS	2 2	LH cowl flap closed valve to blkd union
3	5112589-27	1	1/4 OD x .032 52SO	46-5/8	AF811BT-4D AF811T-4CS	2 2	RH cowl flap closed valve to blkd union
4	5112589-16	1	1/4 OD x .035 52SO	9	AF811BT-4D AF811T-4CS	2 2	Cowl flap pressure line—tee to LH valve
5	5112589-15	1	1/4 OD x .035 52SO	5-1/2	AF811BT-4D AF811T-4CS	2 2	Cowl flap pressure line—tee to RH valve
6	5071030-4-35	4	Hose Assembly				
	1031662-4S	4	Nut				
	or						
	43D2474-4-350	4	Hose Assembly				
	3115-1HT-4	4	Parker Blkd Coupling				
	1031662-4S	4	Nut				
7	5112588-14	1	1/4 OD x .032 52SO	35	AF811BT-4D AF811T-4CS	2 2	RH cowl flap closed line blkd union to blkd union
8	5112588-12	1	1/4 OD x .032 52SO	35-1/2	AF811BT-4D AF811T-4CS	2 2	RH cowl flap open line blkd union to blkd union
9	5112588-13	1	1/4 OD x .032 52SO	60-1/4	AF811BT-4D AF811T-4CS	2 2	RH cowl flap closed line blkd union to blkd union
10	5112588-11	1	1/4 OD x .032 52SO	65-1/2	AF811BT-4D AF811T-4CS	2 2	RH cowl flap open line—blkd union to blkd union
11	5112589-21	1	1/4 OD x .032 52SO	49-1/4	AF811BT-4D AF811T-4CS	2 2	LH cowl flap open line—valve to blkd union
12	5112589-25	1	1/4 OD x .032 52SO	48-1/2	AF811BT-4D AF811T-4CS	2 2	RH cowl flap open valve to blkd union
13	5112589-14	1	1/4 OD x .035 52SO	47-1/2	AF811BT-4D AF811T-4CS	2 2	Cowl flap pressure tee in brake line to tee
14	5112589-10	(Ref)					Brake return line
15	5112589-3	(Ref)					Brake pressure line
16	5112589-54	(Ref)					Brake pressure line
17	5112589-12	(Ref)					Brake return line
18	5112589-28	1	1/4 OD x .032 52SO	148-1/4	AF811BT-4D AF811T-4CS	2 2	RH cowl flap closed line—blkd union to blkd union
19	5112589-26	1	1/4 OD x .032 52SO	145-3/4	AF811BT-4D AF811T-4CS	2 2	RH cowl flap open line—blkd union to blkd union
20	5112589-24	1	1/4 OD x .032 52SO	147-1/4	AF811BT-4D AF811T-4CS	2 2	LH cowl flap closed line—blkd union to blkd union
21	5112589-22	1	1/4 OD x .032 52SO	144-3/4	AF811BT-4D AF811T-4CS	2 2	LH cowl flap open line—blkd union to blkd union
22	5112588-9	1	1/4 OD x .032 52SO	115-7/8	AF811BT-4D AF811T-4CS	2 2	LH cowl flap closed line—blkd union to blkd union
23	5112588-7	1	1/4 OD x .032 52SO	114-1/4	AF811BT-4D AF811T-4CS	2 2	LH cowl flap open line—blkd union to blkd union

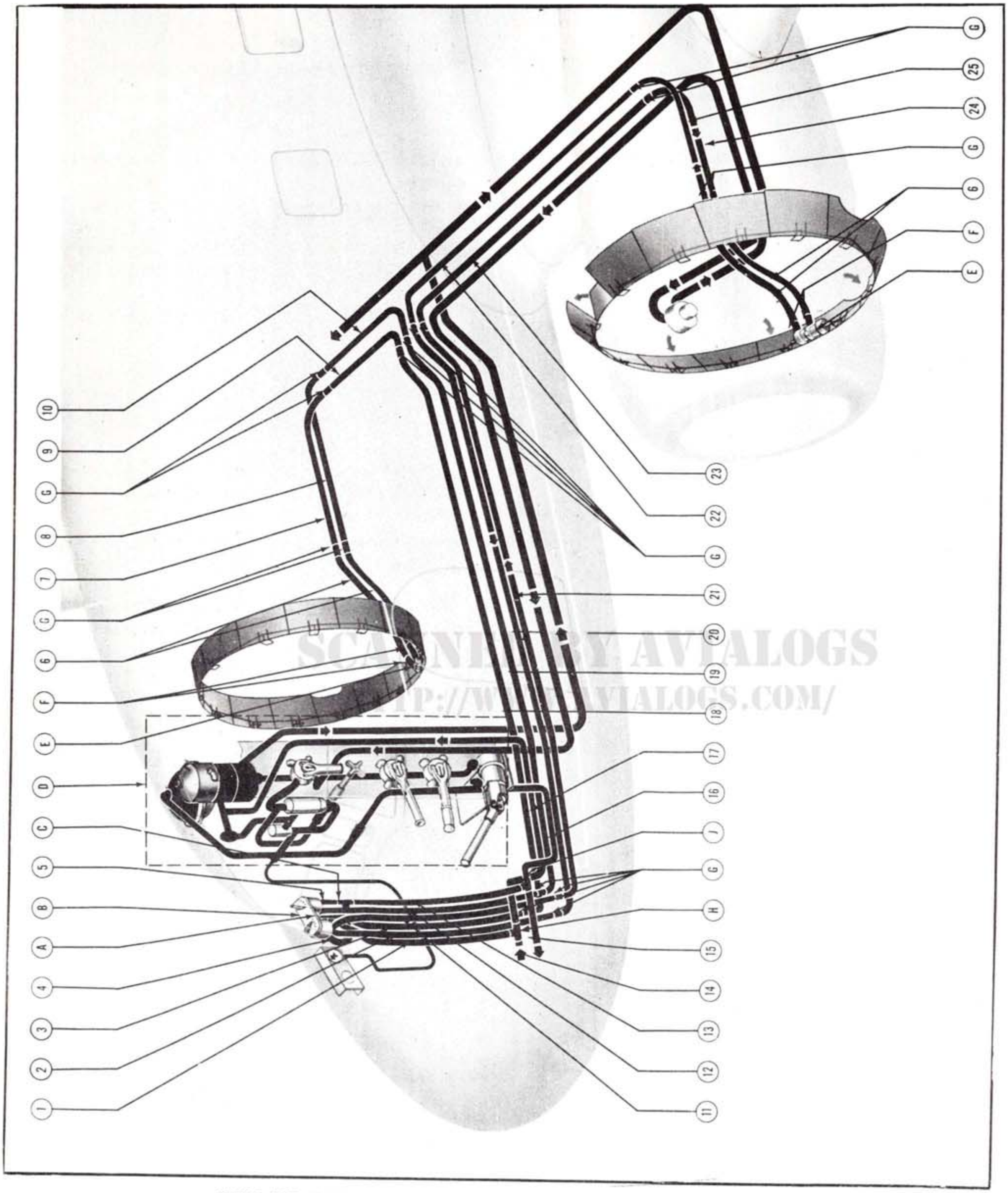

10
9
G
8
7
G
6
F
E
D
C
5
B
A
4
3
2
1
G
25
24
G
6
F
E
23
22
G
21
20
19
18
17
16
J
G
H
15
14
13
12
11

Figure 636—Cowl Flap Hydraulic System (Lines and Fittings)

KEY TO FIGURE 636—C-47 and C-47A Airplanes—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
24	5112588-8	1	1/4 OD x .032 52SO	34-3/8	AF811BT-4D AF811T-4CS	2 2	LH cowl flap open line—blkd union to blkd union
25	5112588-10	1	1/4 OD x .032 52SO	35-1/8	AF811BT-4D AF811BT-4CS	2 2	LH cowl flap closed line—blkd union to blkd union

KEY TO FIGURE 636—C-47B Airplanes

Item	*Part No.*	*Part Name*	*No. Req*
B	4143736	Cowl Flap Control Valve and Bracket Assembly (See figure 422)	1
	Attached by:		
	AN3-10A	Bolt	1
	AN3-6A	Bolt	2
	AAF365-1032	Nut	3
C	1141672	Tee	1
D		(Refer to figure 635A for parts in this area)	
E	2000	Cowl Flap Actuatıng Cylinder (Precision Products)	2
F	4CT-S	Parker Elbow	4
G	3115-1HT-4D	Parker Coupling	16
	11-1039-1-3D	Parker Locknut	16
H	1601-8-8-4-4KTD	Parker Cross	(Ref)
J	1601-6-6-4-4KTD	Parker Cross	(Ref)

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5204914-19	1	1/4 OD x .032 52SO	48	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap return valve to cross brake return
2	5204914-23	1	1/4 OD x .032 52SO	48-1/4	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap closed LH valve to blkd union at RH tunnel
3	5204914-27	1	1/4 OD x .032 52SO	46-5/8	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap closed RH valve to blkd union at RH tunnel
4	5204914-16	1	1/4 OD x .035 52SO	9-1/2	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap supply tee to LH valve
5	5204914-15	1	1/4 OD x .035 52SO	5-1/2	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap supply tee to RH valve
6	AAF43D2475-4-350		Hose Assembly				
		2	Cowl flap closed				
		2	Cowl flap open				
7	5204913-14	1	1/4 OD x .035 52SO	35	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap closed RH blkd union to blkd union
8	5204913-12	1	1/4 OD x .035 52SO	35-1/2	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap open RH blkd union to blkd union
9	5204913-13	1	1/4 OD x .035 52SO	65-1/4	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap closed RH blkd union to blkd union
10	5204913-11	1	1/4 OD x .035 52SO	60-7/8	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap open RH blkd union to blkd union
11	5204914-21	1	1/4 OD x .032 52SO	49-1/4	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap open LH valve to blkd union
12	5204914-25	1	1/4 OD x .032 52SO	48-1/2	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap open RH valve to blkd union

KEY TO FIGURE 636—C-47B Airplanes—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
13	5204914-14	1	1/4 OD x .035 52SO	47-1/2	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap supply cross in brake line to tee
14	5204914-10	(Ref)					Brake return line
15	5204914-3	(Ref)					Brake pressure line
16	5204914-53	(Ref)					Brake pressure line
17	5204914-12	(Ref)					Brake return line
18	5204914-28	1	1/4 OD x .032 52SO	148-1/4	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap closed RH blkd union to blkd union
19	5204914-26	1	1/4 OD x .032 52SO	145-3/4	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap open RH blkd union to blkd union
20	5204914-24	1	1/4 OD x .032 52SO	147-3/4	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap closed LH blkd union to blkd union
21	5204914-22	1	1/4 OD x .032 52SO	145-1/4	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap open LH blkd union to blkd union
22	5204913-9	1	1/4 OD x .035 52SO	115-1/2	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap closed LH blkd union to blkd union
23	5204913-7	1	1/4 OD x .035 52SO	113-3/4	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap open LH blkd union to blkd union
24	5204913-8	1	1/4 OD x .035 52SO	34-3/8	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap open LH blkd union to blkd union
25	5204913-10	1	1/4 OD x .035 52SO	35-1/8	AAF811BT-4D AAF811T-4CS	2 2	Cowl flap closed LH blkd union to blkd union

KEY TO FIGURE 637—C-47 and C-47A Airplanes

(Douglas Dwg. Nos. 5110553, 5141942, 5110513, and 5141943)

Item	*Part No.*	*Part Name*	*No. Req*
A	3118562	Wing Flap Indicator (See figure 424)	(Ref)
B		Wing Flap Relief Valve Assembly (See figure 432)	(Ref)
C	404-LGT-6	Check Valve (Parker)	(Ref)
D		(For parts within this area refer to figure 635)	(Ref)
E	AF811HT-6D	Union	2
F	3115-1HT-6	Bulkhead Coupling	2
	1031662-6S	Nut	2
G	5117384	Wing Flap Actuating Cylinder (See figure 428)	1
H	1118053	Bearing	1
	AN35A	Bolt	2
	AN960-10	Washer	2
	AF365-1032	Nut	2
I	AF811-HT-8D	Union	1
J	1139387	Orifice Check Valve	1

KEY TO FIGURE 637—C-47 and C-47A Airplanes—Continued

Item	*Part No.*	*Part Name*	*No. Req*
K	4118984	Wing Flap Control Valve (See figure 390)	(Ref)
L	2119831	Fitting	2
	143908-018D028-064	Washer	2
	11-1039-1-5	Parker Lock Nut	2

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5118162-11	1	3/8 OD x .035 52SO	11	AF811BT-8D AF811T-8CS	2 2	Bypass line—check valve to elbow
2	5118162-8	(Ref)	1/2 OD x .035 52SO	17-3/4	AF811BT-8D AF811T-8CS	2 2	Wing flap up line—control valve to tee
3	5112589-49	1	1/2 OD x .049 52SO	33	AF811BT-8D AF811T-8CS	2 2	Wing flap up line—tee to union
4	5112589-52	1	1/2 OD x .049 52SO	26-3/4	AF811BT-8D AF811T-8CS	2 2	Wing flap down line—tee to check valve
5	5118162-9	1	1/2 OD x .042 52SO	5-1/4	AF811BT-8D AF811T-8CS	2 2	Wing flap down line—control valve to tee
6	5112589-50	1	1/2 OD x .049 52SO	110-3/4	AF811BT-8D AF811T-8CS	2 2	Wing flap up line—union to blkd union
7	5112589-53	1	1/2 OD x .049 52SO	109	AF811BT-8D AF811T-8CS	2 2	Wing flap down line—check valve to union
8	5112588-35	1	3/8 OD x .042 52SO	68-1/2	AF811BT-6D AF811T-6CS	2 2	Wing flap up line—blkd union to union
9	5112588-37	1	3/8 OD x .042 52SO	72	AF811BT-6D AF811T-6CS	2 2	Wing flap down line—blkd union to union
10	5112588-36	1	3/8 OD x .042 52SO	50	AF811BT-6D AF811T-6CS	2 2	Wing flap up line—union to hose coupling
11	5112588-38	1	3/8 OD x .042 52SO	45	AF811BT-6D AF811T-6CS	2 2	Wing flap down line—union to hose coupling
12	2117251-1	1	3/8 OD x .042 52SO	36	AF811BT-6D AF811T-6CS	2 2	Wing flap up line—coupling to elbow on cylinder
13	5071030-6-38 or	2	Hose Assembly (Some Airplanes)				
	43D2474-6-380	2	Hose Assembly (Some Airplanes)				

KEY TO FIGURE 637—C-47B Airplanes

Item	*Part No.*	*Part Name*	*No. Req*
D		(For parts within this area refer to figure 635A)	(Ref)
E	AAF811-HT-6D	Union	2
F	S1031662-6S	Nut	2
G	5209970	Wing Flap Actuating Strut Assembly (See figure 428A)	1
H	1118053	Bearing	1
	AN3-5A	Bolt	2
	AN960-10	Washer	2
	AN365-1032	Nut	2
I	AAF811-HT-8D	Union	1
J	1139387	Orifice Check Valve	1
L	2119831	Fitting	2
	S143908-018D028-064	Washer	2
	11-1039-1-5	Parker Lock Nut	2

KEY TO FIGURE 637—C-47B Airplanes—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
6	5204914-49	1	1/2 OD x .049 52SO	112	AAF811BT-8D AAF811T-8CS	2 2	Wing flap up—union to blkd union
7	5204914-52	1	1/2 OD x .049 52SO	110	AAF811BT-8D AAF811T-8CS	2 2	Wing flap down—check valve to blkd union
8	5204913-31	1	3/8 OD x .042 52SO	68-1/2	AAF811BT-6D AAF811T-6CS	2 2	Wing flap up—blkd union to union
9	5204913-33	1	3/8 OD x .042 52SO	72	AAF811BT-6D AAF811T-6CS	2 2	Wing flap down—blkd union to union
10	5204913-32	1	3/8 OD x .042 52SO	50	AAF811BT-6D AAF811T-6CS	2 2	Wing flap up—union to hose
11	5204913-34	1	3/8 OD x .042 52SO	45	AAF811BT-6D AAF811T-6CS	2 2	Wing flap down—union to hose
12	2117251-1	1	3/8 OD x .042 52SO	36	AAF811BT-6D AAF811T-6CS	2 2	Wing flap up line—coupling to elbow on cylinder
13	2189609	2	Hose Assembly				

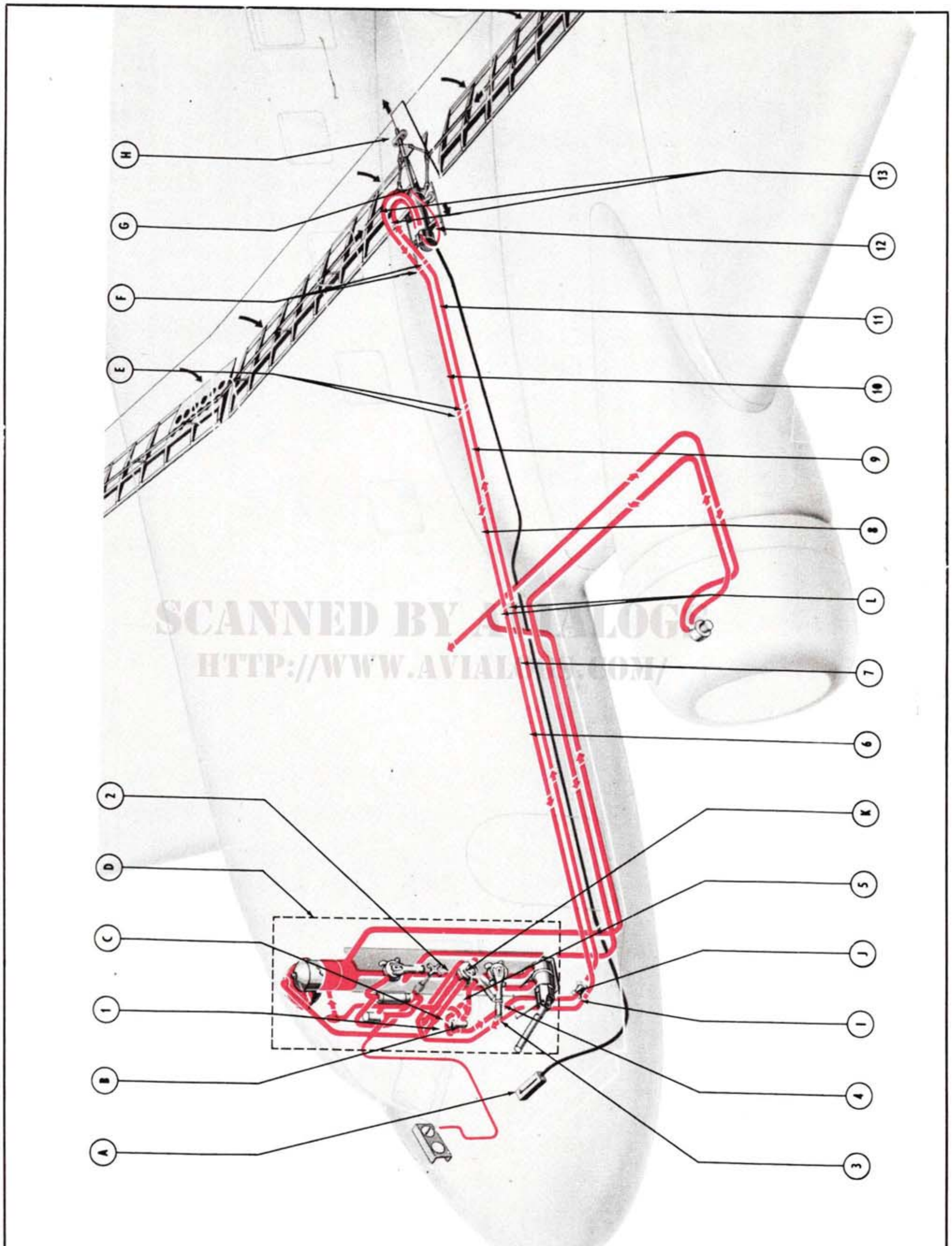

H
G
F
E
2
D
C
1
B
A
13
12
11
10
9
8
L
7
6
K
5
J
I
4
3

Figure 637—Wing Hydraulic System *(Lines and Fittings)*

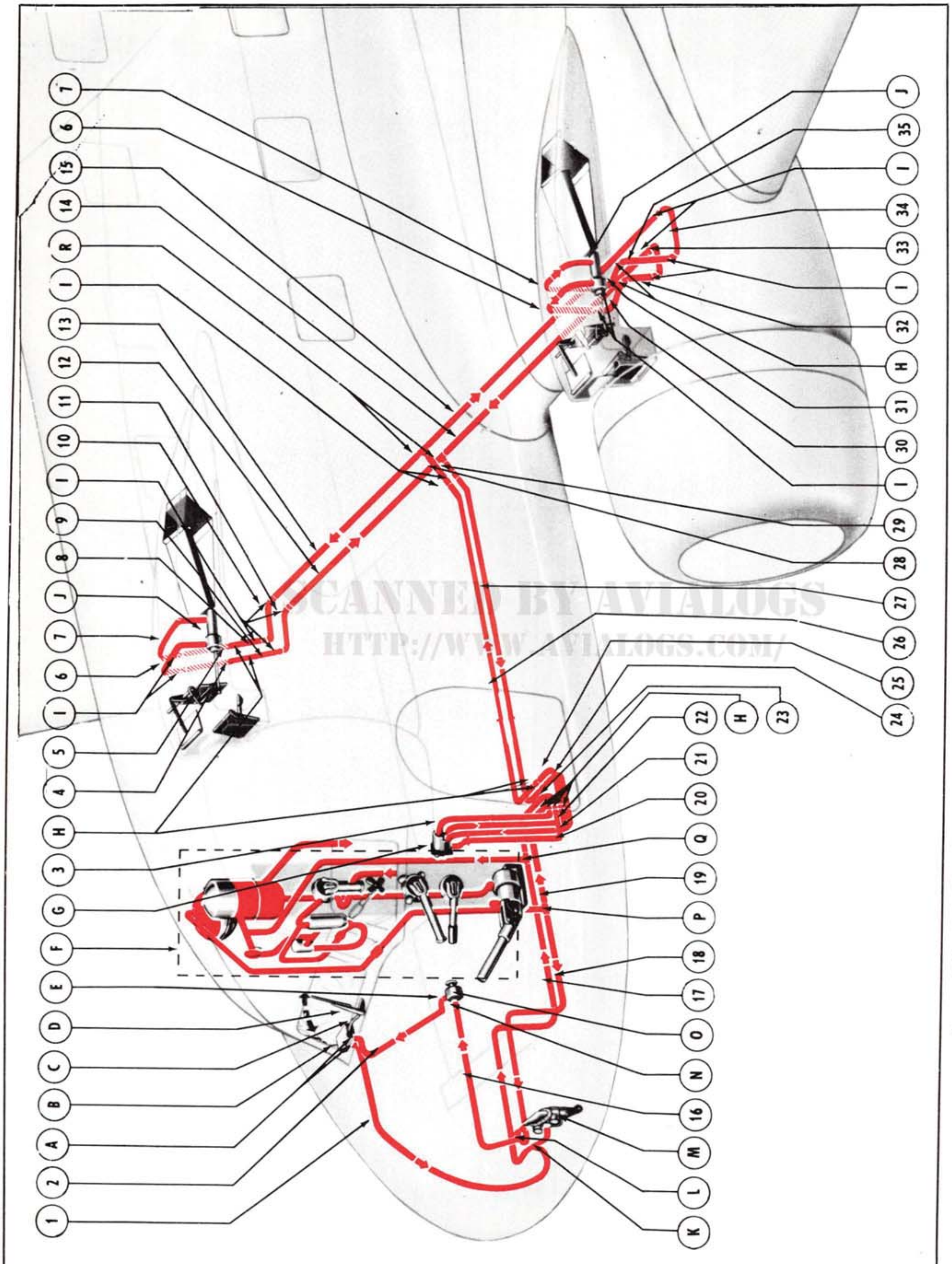

1
2
A
B
C
D
E
F
G
3
H
4
5
I
6
7
J
8
9
I
10
11
12
13
I
R
14
15
6
7
J
35
I
34
33
I
32
H
31
30
I
29
28
27
26
25
24
23
H
22
21
20
Q
19
P
18
17
O
N
16
M
L
K

Figure 638—Windshield Wiper and Nonram Air Scoop Hydraulic Systems (Lines and Fittings)

KEY TO FIGURE 638

(Douglas Drawing Nos. 5141943, 5141942, 5204439, and 5137181)

Item	*Part No.*	*Part Name*	*No. Req*
A	AF811CT4D	Elbow	2
*B	G50020	Motor Control Assembly	1
*C	D50197	LH Cable Control Assembly	1
	*D50196	RH Cable Control Assembly	1
*D	G14182	Window Control	2
	*B11830	Drive Arm	2
	*B12016	Wiper Blade Assembly	2
E	AF811CT45-4D	Elbow	1
F		(For Parts Within this area refer to figure 635)	(Ref)
G	4141612	Valve Assembly	1
	2141904	Bracket	1
H	AF811-HT-4D	Union	10
I	3115-1HT-4D	Parker Coupling	14
	11-1039-1-3D	Lock Nut	14
J	2203170	Cylinder Assembly	2
	AN23-19	Clevis Bolt	4
	AN320-3	Shear Nut	4
	AN380-2-2	Cotter Pin	4
	1026614-3-012	Spacer	4
	AN960-516L	Washer	8
K	AF811-JT-4D	Tee	2
L	8-8-4-6 KST-D	Parker Cross	(Ref)
M	6-6-4-4-KT-D	Parker Cross	(Ref)
N		Brake Control Valve (See figure 640)	(Ref)
O	AF811FT-4D	Nipple	1
P	B50102	Valve (With .035 dia orifice)	1
	AN515B6-20	Screw	4
	AF365-D632	Nut	4
Q	AF811-JT-6-6-4D	Tee	(Ref)
R	AF811-JT-8-8-4D	Tee	(Ref)

*These parts may be purchased as a unit under part No. K45002—Acrotorque Co., Cleveland, Ohio.

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	2137513-3	1	1/4 OD x .032 52SO	68-1/2	AF811BT4D AF811T4CS	2 2	Return line—wiper motor to cross in brake return line
2	2137513-1	1	1/4 OD x .032 52SO	8-1/2	AF811BT4D AF811T4CS	2 2	Pressure line—control valve to wiper motor
3	5112589-57	1	1/4 OD x .032 52SO	34	AF811BT4D AF811T4CS	2 2	Carb air filter pressure line—control valve to union
4	4203427-7	1	1/4 OD x .035 52SO	24-1/2	AF811BT4D AF811T4CS	2 2	RH carb air filter open line—blkd union to union
5	4203427-8	1	1/4 OD x .035 52SO	23-3/4	AF811BT4D AF811T4CS	2 2	RH carb air filter closed line—blkd union to union
6	2205248-2	2	Hose Assembly				
7	2205248-4	2	Hose Assembly				
8	4203427-4	1	1/4 OD x .035 52SO	38	AF811BT4D AF811T4CS	2 2	RH carb air filter closed line blkd union to union
9	4203427-3	1	1/4 OD x .035 52SO	38	AF811BT4D AF811T4CS	2 2	RH carb air filter open line blkd union to union
10	5112588-62	1	1/4 OD x .035 52SO	35-1/4	AF811BT4D AF811T4CS	2 2	RH carb air filter closed line blkd union to blkd union

KEY TO FIGURE 638—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
11	5112588-61	1	1/4 OD x .035 52SO	37-1/4	AF811BT4D AF811T4CS	2 2	RH carb air filter open line—blkd union to blkd union
12	5112588-43	1	1/4 OD x .035 52SO	56	AF811BT4D AF811T4CS	2 2	RH carb air filter open line—tee to blkd union
13	5112588-44	1	1/4 OD x .035 52SO	63	AF811BT4D AF811T4CS	2 2	RH carb air filter closed line—tee to blkd union
14	5112588-41	1	1/4 OD x .035 52SO	115-1/2	AF811BT4D AF811T4CS	2 2	LH carb air filter open line—tee to blkd union
15	5112588-42	1	1/4 OD x .035 52SO	110-1/2	AF811BT4D AF811T4CS	2 2	LH carb air filter closed line—tee to blkd union
16	2137513-2	1	1/4 OD x .032 52SO	59	AF811BT4D AF811T4CS	2 2	Pressure line—control valve to cross in brake pressure line
17		(Ref)					Brake return line
18		(Ref)					Brake pressure line
19	5112589-61	1	1/4 OD x .032 52SO	42	AF811BT4D AF811T4CS	2 2	Carb air filter pressure line—tee to union
20	5112589-60	1	1/4 OD x .032 52SO	30	AF811BT4D AF811T4CS	2 2	Carb air filter return line—control valve to union
21	5112589-58	1	1/4 OD x .032 52SO	33	AF811BT4D AF811T4CS	2 2	Carb air filter open line—control valve to union
22	5112589-59	1	1/4 OD x .032 52SO	33	AF811BT4D AF811T4CS	2 2	Carb air filter closed line—control valve to union
23	5112589-64	1	1/4 OD x .032 52SO	43	AF811BT4D AF811T4CS	2 2	Carb air filter return line—union to tee
24	5112589-63	1	1/4 OD x .032 52SO	36	AF811BT4D AF811T4CS	2 2	Carb air filter closed line—union to union
25	5112589-62	1	1/4 OD x .032 52SO	37	AF811BT4D AF811T4CS	2 2	Carb air filter open line—union to union
26	5112589-65	1	1/4 OD x .032 52SO	120	AF811BT4D AF811T4CS	2 2	Carb air filter open line—union to blkd union
27	5112589-66	1	1/4 OD x .032 52SO	120	AF811BT4D AF811T4CS	2 2	Carb filter closed line—union to blkd union
28	5112588-39	1	1/4 OD x .035 52SO	11	AF811BT4D AF811T4CS	2 2	Carb air filter open line—blkd union to tee
29	5112588-40	1	1/4 OD x .035 52SO	10	AF811BT4D AF811T4CS	2 2	Carb air filter closed line—blkd union to tee
30	4203427-5	1	1/4 OD x .035 52SO	24-1/2	AF811BT4D AF811T4CS	2 2	LH carb air filter open line—blkd union to union
31	4203427-6	1	1/4 OD x .035 52SO	23-1/2	AF811BT4D AF811T4CS	2 2	LH carb air filter closed line blkd union to union
32	4203427-1	1	1/4 OD x .035 52SO	22-1/2	AF811BT4D AF811T4CS	2 2	LH carb air filter closed line—blkd union to union
33	5112588-59	1	1/4 OD x .035 52SO	36-5/8	AF811BT4D AF811T4CS	2 2	LH carb air filter open line—blkd union to blkd union
34	5112588-60	1	1/4 OD x .035 52SO	34-3/8	AF811BT4D AF811T4CS	2 2	LH carb air filter closed line—blkd union to blkd union
35	4203427-2	1	1/4 OD x .035 52SO	22-1/2	AF811BT4D AF811T4CS	2 2	LH carb air filter closed-line blkd union to union

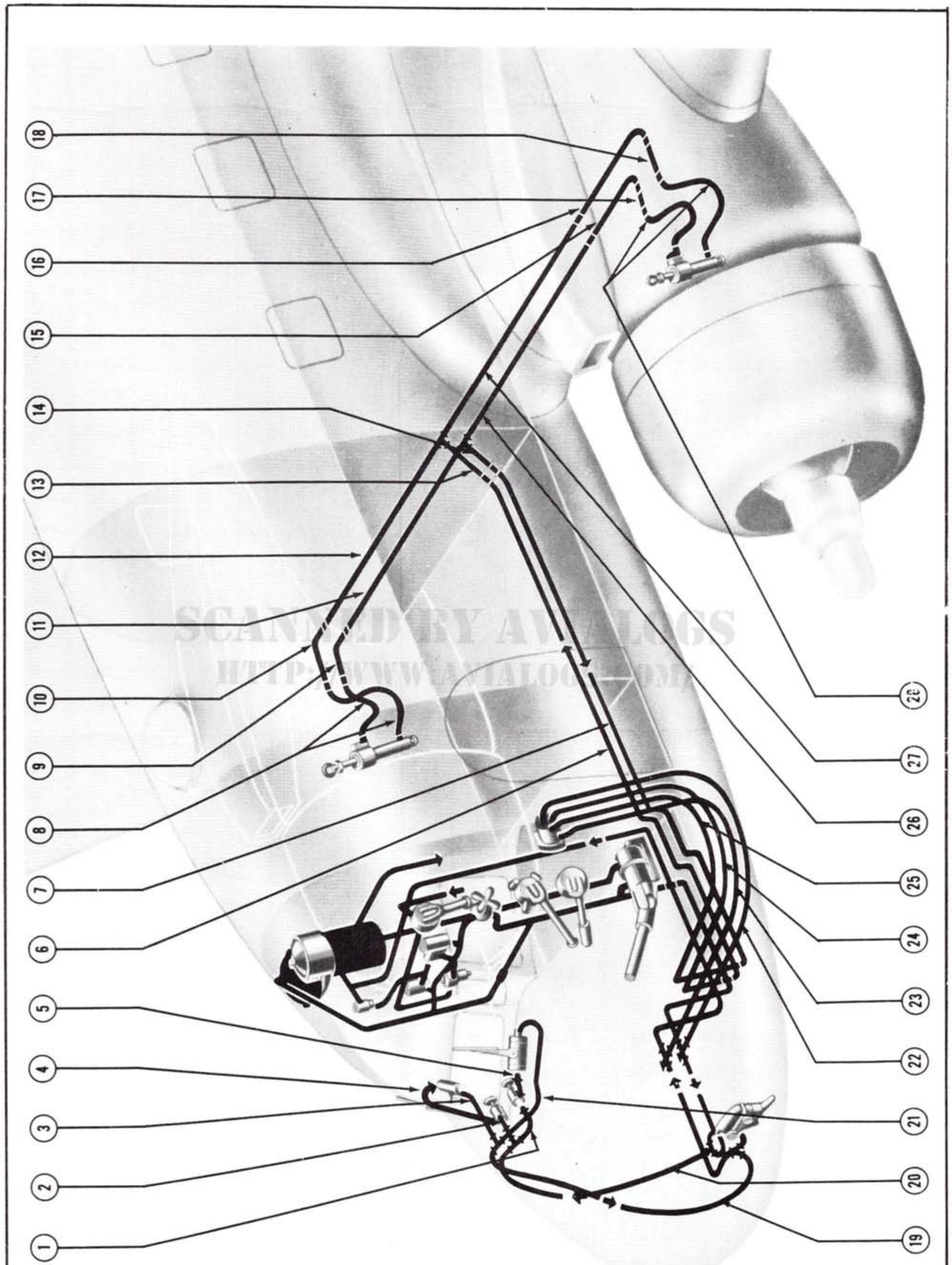

18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
28
27
26
25
24
23
22
21
20
19

Figure 638A—Blower Control and Windshield Wiper Hydraulic Systems (Lines and Fittings)—Late C-47B Airplanes

KEY TO FIGURE 638A (Lines)

(All lines are 1/4 OD x .035, 52SO Aluminum Alloy)

Item	*Part No.*	*No. Req*	*Lgth*	*Fittings*	*Ftgs per Line*	*Location or Description*
1	5204914-94	1	8-1/2	AAF811BT-4D AAF8114CS	2 2	Pressure—tee to LH valve
2	5204914-93	1	4-1/2	AAF811BT-4D AAF8114CS	2 2	Pressure—tee to RH valve
3	5204914-89	1	12	AAF811BT-4D AAF8114CS	2 2	Return line—RH windshield wiper motor to tee
4	5204914-86	1	14	AAF811BT-4D AAF8114CS	2 2	Pressure line—RH windshield wiper motor to control valve
5	5204914-85	1	9	AAF811BT-4D AAF8114CS	2 2	Pressure line—between LH control valve and windshield wiper motor
6	5204914-76	1	149-3/4	AN818-4D AN819-4D	2 2	"High" blower—fwd connector plate to center-wing fuselage con. plate
7	5204914-77	1	149-3/8	AN818-4D AN819-4D	2 2	"Low" blower—fwd connector plate to center-wing fuselage con. plate
8	AAF43D2474-4-300	2				Hose assy "high" and "low" blower —RH firewall to actuating cylinder
9	5204913-58	1	43-1/2	AN818-4D AN819-4D	2 2	"Low" blower—RH canted rib connector plate to firewall
10	5204913-57	1	43-1/2	AN818-4D AN819-4D	2 2	"High" blower—RH canted rib con. plate to RH firewall connector plate
11	5204913-54	1	66	AN818-4D AY819-4D	2 2	"Low" blower—tee to RH canted rib connector plate
12	5204913-53	1	64	AN818-4D AN819-4D	2 2	"High" blower—tee to RH canted rib connector plate
13	5204913-61	1	15	AN818-4D AN819-4D	2 2	"High" blower—center-wing fuselage connector plate to tee
14	5204913-62	1	15	AN818-4D AN819-4D	2 2	"Low" blower—center-wing fuselage connector plate to tee
15	5204913-60	1	43-1/2	AN818-4D AN819-4D	2 2	"Low" blower—LH canted rib connector plate to LH ribwall connector plate
16	5204913-59	1	43-1/2	AN818-4D AN819-4D	2 2	"High" blower—LH canted rib con. plate to LH firewall connector plate
17	5204912-22	1	41-1/2	AAF811BT-4D AAF811T-4CS	2 2	"Low" blower—LH firewall to bracket
18	5204912-21	1	41-1/2	AAF811BT-4D AAF811T-4CS	2 2	"High" blower—LH firewall to bracket
19	5204914-87	1	56	AAF811BT-4D AAF811-4CS	2 2	Return line—tee to cross-brake hydraulic system
20	5204914-90	1	65	AAF811BT-4D AAF811-4CS	2 2	Pressure line—tee to cross-brake hydraulic system
21	5204914-88	1	24	AAF811BT-4D AAF8114CS	2 2	Return line—LH windshield wiper motor to tee
22	5204914-68	1	83	AN818-4D AN819-4D	2 2	Pressure—blower control to cross
23	5204914-69	1	83	AN818-4D AN819-4D	2 2	Return—blower control to cross
24	5204914-70	1	77	AN818-4D AN819-4D	2 2	"High" blower—control to connector plate
25	5204914-71	1	77	AN818-4D AN819-4D	2 2	"Low" blower—blower control to connector plate
26	5204913-56	1	115	AN818-4D AN819-4D	2 2	"Low" blower—tee to LH canted rib connector plate
27	5204913-55	1	117	AN818-4D AN819-4D	2 2	"High" blower—tee to LH canted rib connector plate
28	AAF43D2474-4300	2				Hose assembly "high" and "low" blower—LH bracket to cylinder

KEY TO FIGURE 638A (Fittings)

Item	*Part No.*	*Name and Location*	*No. Req*
1	AAF811-FT-4D	Nipple—at LH control valve	1
2	AAF811-JT-4D	Tee—at fwd end of line	1
	AAF811-FT-4D	Nipple—at RH control valve	1
3	AN832-4D	Union—at RH windshield wiper motor	1
	AN924-4D	Nut—at RH windshield wiper motor	1
	AN6227-7	"O" ring—at RH windshield wiper motor	1
4	AN833-4D	90° elbow—at RH windshield wiper motor	1
	AN924-4D	Nut—at RH windshield wiper motor	1
	AN6227-7	"O" ring—at RH windshield wiper motor	1
	AAF811CT45-4D	Elbow—at LH control valve	1
5	AN832-4D	Union—at LH windshield wiper motor	1
	AN924-4D	Nut—at LH windshield wiper motor	1
	AN6227-7	"O" ring—at LH windshield wiper motor	1
	AAF811CT45-4D	Elbow—at LH control valve	1
6	Parker 3115-1HT-4D	Coupling—at fwd connector plate	1
	Parker 11-1039-1-3D	Locknut—at fwd connector plate	1
7	Parker 3115-1HT-4D	Coupling—at fwd connector plate	1
	Parker 11-1039-1-3D	Locknut—at fwd connector plate	1
8	3175-3-4D	Parker union—"high" blower—at cylinder connection	1
	AAF40B887-014C022-16	Gasket—"high" blower—at cylinder connection	2
	AAF40B-374-4D	Bolt—"low" blower—at cylinder connection	1
	AAF40D-370-4D	Swivel coupling—"low" blower—at cylinder connection	1
	AAF40B-887-014AD22-16	Gasket—"low" blower—at cylinder connection	1
10	AN832-4D	Bulkhead coupling—one each at each connector plate, RH	2
	AN924-4D	Locknut—one each at each connector plate, RH	2
13	AN832-4D	Union—at connector plate	1
	AN924-4D	Nut—at connector plate	1
	AAF811JT-4D	Tee—at aft end of —61 line	1
14	AN832-4D	Union—at connector plate	1
	AN924-4D	Nut—at connector plate	1
	AAF811JT-4D	Tee—at aft end of —62 line	1
15	AN832-4D	Bulkhead coupling—one at each connector plate	2
	AN942-4D	Locknut—one at each connector plate	2
16	AN832-4D	Bulkhead coupling—one each at each end of line	2
	AN924-4D	Locknut—one each at each end of line	2
17	Parker 3115-1HT-4D	Bulkhead coupling—at bracket	1
	Parker 11-1039-1-3D	Locknut—at bracket	1
18	Parker 3115-1HT-4D	Bulkhead coupling—at bracket	1
	Parker 11-1039-1-3D	Locknut—at bracket	1
21	AAF811JT-4D	Tee—at junction of windshield wiper return lines	1
	AN833-4D	90° elbow—at LH windshield wiper motor	1
	AN924-4D	Nut—at LH windshield wiper motor	1
	AN6227-7	"O" ring—at LH windshield wiper motor	1
22	AN815-4D	Union—at control	1
	1601-6-6-4-4KDT	Cross (Parker)—at junction with brake lines	1
23	AN815-4D	Union—at control	1
	1601-8-8-4-4KDT	Cross (Parker)—at junction with brake line	1
24	AN815-4D	Union—at control	1
25	AN815-4D	Union—at control	1
28	3175-3-4D	Parker union—"high" blower—at cylinder connector	1
	AAF40B887-014C022-16	Gasket—"high" blower—at cylinder connector	2
	AAF40D370-4D	Swivel coupling—"low" blower—at cylinder coupling	1
	AAF40B-374-4D	Bolt—"low" blower—at cylinder coupling	1
	AAF40B887-014AD22-16	Gasket—"low" blower—at cylinder coupling	1

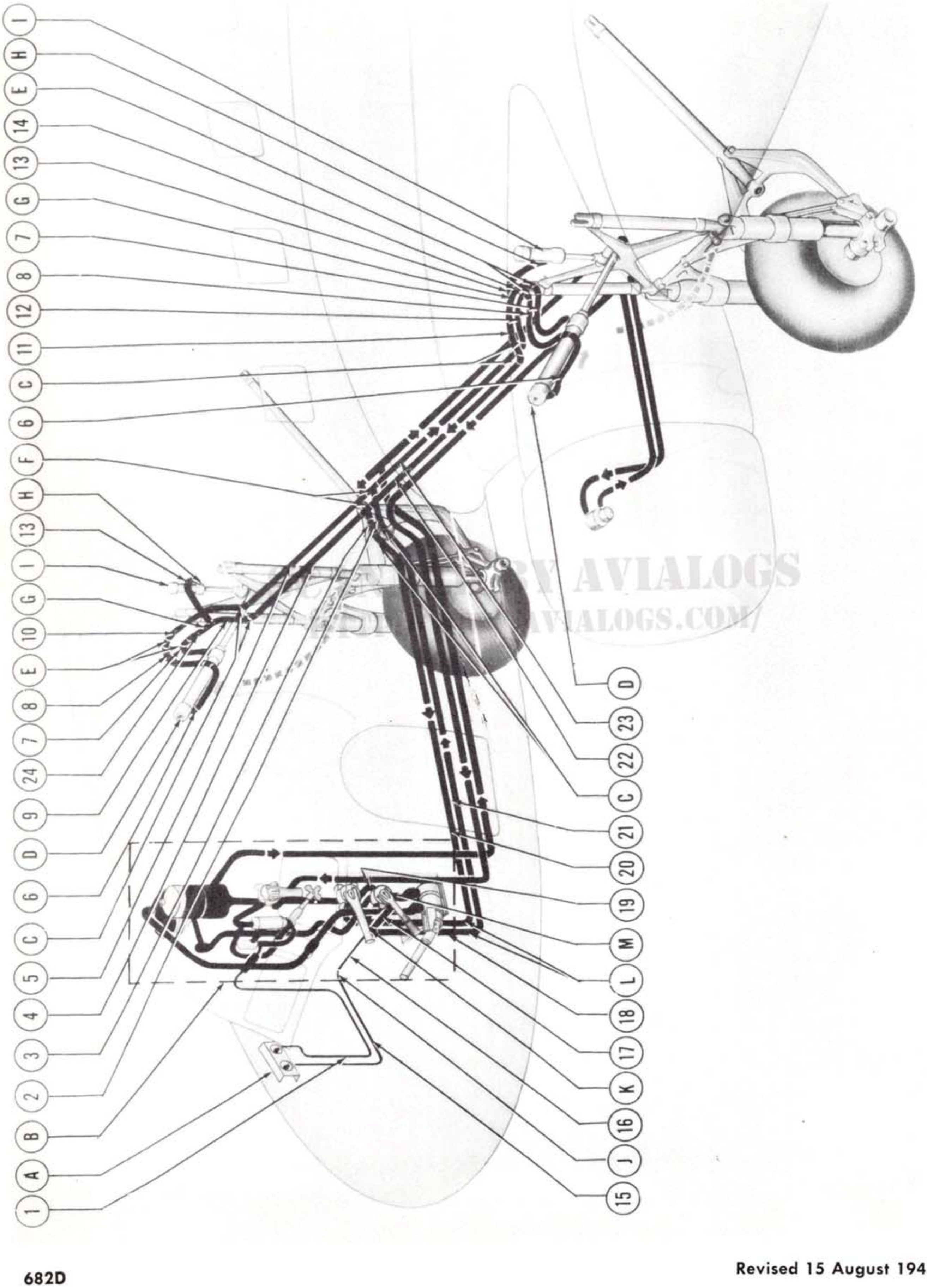

I
H
E
14
13
G
7
8
12
11
C
6
F
H
13
I
G
10
E
8
7
24
9
D
6
C
5
4
3
2
B
A
1
D
23
22
C
21
20
19
M
L
18
17
K
16
J
15

Figure 639—Landing Gear Hydraulic System (Lines and Fittings)

KEY TO FIGURE 639—C-47 and C-47A Airplanes

(Douglas Drawing Nos. 5110513, 5141942, 5110553 and 5141943)

Item	*Part No.*	*Part Name*	*No. Req*
A	4119659	Gage Assembly (See figure 634)	(Ref)
B		(Refer to figure 635 for other parts within this area)	(Ref)
C	3115-1HT-8D	Parker Blkd Coupling	4
	11-1039-1-10D	Lock Nut	4
D	5140045	Landing-Gear Actuating Cylinder and Line Assembly (See figure 392)	2
E	8-CT-45°-5	Parker Elbow	4
F	AF811JT-8D	Tee	2
G	AF811JT-8-8-6	Tee (On Airplanes with Hydraulic Compensator)	2
H	AN921-6D	Elbow	2
I	22087	Hydraulic Compensator Cylinder (Some Airplanes. See figure 129)	2
J	3115-1ET-4D	Parker Elbow	1
	1031662-4S	Lock Nut	1
K	8-4-8JT-S	Parker Tee	(Ref)
L	8-HT-S	Parker Union	2
M		Landing-Gear Control Valve (See figure 635)	(Ref)

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5112589-56	(Ref)					System pressure gage line (See figure 634)
2	5112588-28	1	1/2 OD x .049 52SO	9-1/2	AF811BT8D AF811T8CS	2 2	Landing-gear down line—blkd union to tee
3	5112588-25	1	1/2 OD x .049 52SO	7-1/4	AF811BT8D AF811T8CS	2 2	Landing-gear up line—blkd union to tee
4	5112588-26	1	1/2 OD x .049 52SO	58-1/4	AF811BT8D AF811T8CS	2 2	RH landing-gear up line—tee to blkd union
5	5112588-29	1	1/2 OD x .049 52SO	62-1/2	AF811BT8D AF811T8CS	2 2	RH landing-gear down line—tee to blkd union
**6	2139370-1 or	(Ref)	1/2 OD x .049 52SO	28	AF811BT8D AF811T8CS	2 2	Landing-gear down line—hose to elbow in cylinder
	2139370 2	(Ref)	1/2 OD x .049 52SO	29	AF811BT8D AF811T8CS	2 2	
**7	2118392-1	(Ref)	Hose Assembly				Landing-gear up line
**8	2118392-2	(Ref)	Hose Assembly				Landing-gear down line
***9	5112588-56	1	1/2 OD x .049 52SO	52	AF811BT8D AF811T8CS	2 2	RH landing-gear up line—blkd union to hose
10	5112588-54	1	1/2 OD x .049 52SO	53-1/2	AF811BT8D AF811T8CS	2 2	RH landing-gear down line—blkd union to elbow
*11	5112588-79	1	1/2 OD x .049 52SO	34-1/2	AF811BT8D AF811T8CS	2 2	LH landing-gear up line—blkd union to tee
12	5112588-53	1	1/2 OD x .049 52SO	53-1/2	AF811BT8D AF811T8CS	2 2	LH landing-gear down line—blkd union to elbow
13	2205622	2	Hose Assembly				Landing-gear up line—tee to hydraulic compensator
*14	5112588-81	1	1/2 OD x .049 52SO	18	AF811BT8D AF811T8CS	2 2	LH landing-gear up line—tee to elbow
15	5112589-55	1	1/4 OD x .032 52SO	55-1/4	AF811BT4D AF811T4CS	2 2	Landing-gear gage line—blkd elbow to gage
16	5112589-29	1	1/4 OD x .032 52SO	23-1/2	AF811BT4D AF811T4CS	2 2	Landing-gear gage line—tee to bulkhead elbow

KEY TO FIGURE 639—C-47 and C-47A Airplanes—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
17	5112589-31	(Ref)	1/2 OD x .049 52SO	6-1/4	AF811BT8D AF811T8CS	2 2	Landing-gear down line—control valve to tee
18	5112589-32	1	1/2 OD x .049 52SO	17	AF811BT8D AF811T8CS	2 2	Landing-gear down line—tee to union
19	5112589-33	(Ref)	1/2 OD x .049 52SO	24	AF811BT8D AF811T8CS	2 2	Landing-gear up line—control valve to union
20	5112589-34	1	1/2 OD x .049 52SO	117	AF811BT8D AF811T8CS	2 2	Landing-gear up line—union to bulkhead union
21	5112589-20	1	1/2 OD x .049 52SO	114-1/2	AF811BT8D AF811T8CS	2 2	Landing-gear down line—union to blkd union
22	5112588-31	1	1/2 OD x .049 52SO	115	AF811BT8D AF811T8CS	2 2	LH landing-gear up line—tee to blkd union
23	5112588-33	1	1/2 OD x .049 52SO	111	AF811BT8D AF811T8CS	2 2	LH landing-gear down line—tee to blkd union
*	5112588-55	1	1/2 OD x .049 52SO	55	AF811BT8D AF811T8CS	2 2	LH landing-gear up line—blkd union to elbow installed instead of items 11 and 14 on airplanes with shock cord bungee
***	5112588-80	1	1/2 OD x .049 52SO	32-1/2	AF811BT8D AF811T8CS	2 2	RH landing-gear up line—blkd union to tee
***	5112588-82	1	1/2 OD x .049 52SO	16	AF811BT8D AF811T8CS	2 2	RH landing-gear up line—tee to elbow

Notes

***Item 9 replaced by these two lines on airplanes with hydraulic compensator installation.

**Items 6, 7, and 8 are a part of 5140045 landing-gear actuating cylinder and line assembly. See item L.

KEY TO FIGURE 639—C-47B Airplanes

Item	*Part No.*	*Part Name*	*No. Req*
A	4119659	Gage Assembly (See figure 634)	(Ref)
B		(Refer to figure 635A for parts within this area)	(Ref)
C	3115-1HT-8D	Parker Coupling	6
	11-1039-1-10D	Parker Locknut	6
D	5140045	Ldg Gear Actuating Cylinder and Line Assem (See figure 392)	2
E	8-CT-45°-S	Parker Elbow	4
F	AAF811JT-8D	Tee	2
G	8-8-6-JT-S	Parker Tee	2
H	AAF811-CT-6NS	Elbow	2
I	4189700	Hydraulic Compensator Cylinder (See figure 129)	2
J	3115-1ET-4D	Parker Elbow	1
K	8-4-8JTS	Parker Tee	1
L	8-HT-S	Parker Union	2
M		Landing Gear Control Valve (See figure 635A)	(Ref)

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5204914-55	1	1/4 OD x .032 52SO	56-1/4	AAF811BT-4D AAF811T-4CS	2 2	System pressure gage blkd elbow to gage
2	5204913-27	1	1/2 OD x .049 52SO	9-1/2	AAF811BT-8D AAF811T-8CS	2 2	Landing gear down blkd union to tee

KEY TO FIGURE 639—C-47B Airplanes—Continued

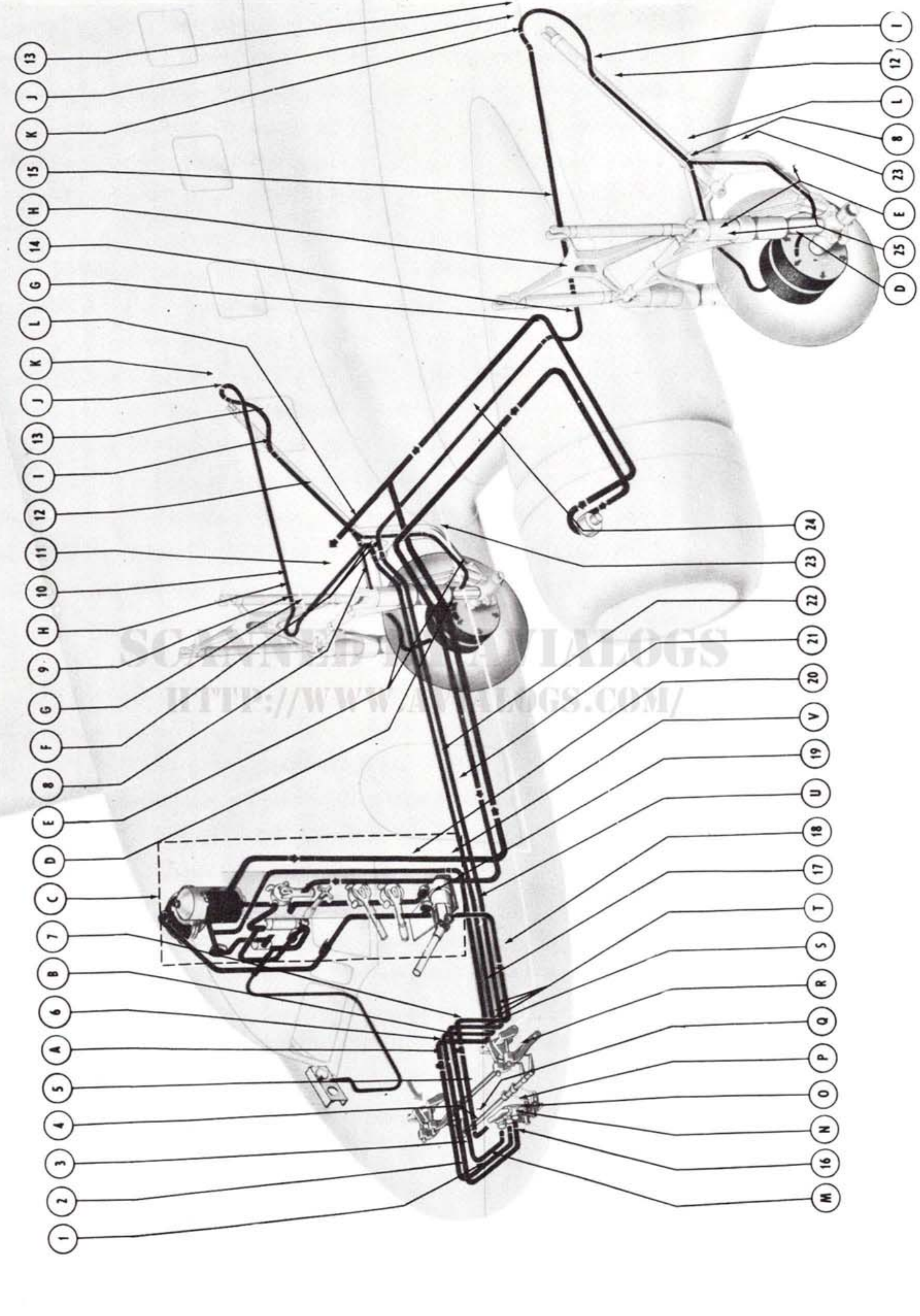
Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
3	5204913-25	1	1/2 OD x .049 52SO	7-1/4	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up blkd union to tee
4	5204913-26	1	1/2 OD x .049 52SO	58-1/4	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up RH tee to blkd union
5	5204913-28	1	1/2 OD x .049 52SO	62-1/2	AAF811BT-8D AAF811T-8CS	2 2	Landing gear down RH tee to blkd union (nacelle)
6	2139370-3	(Ref)	Hose Assembly				
7	2118392-1	(Ref)	Hose Assembly				Landing gear up
8	2118392-2	(Ref)	Hose Assembly				Landing gear down
9	5204913-52	1	1/2 OD x .049 52SO	32-1/2	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up RH blkd union to tee
10	5204913-42	1	1/2 OD x .049 52SO	53-3/16	AAF811BT 8D AAF811T-8CS	2 2	Landing gear down RH blkd union to hose
11	5204913-51	1	1/2 OD x .049 52SO	34-1/2	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up LH blkd union to tee
12	5204913-41	1	1/2 OD x .049 52SO	50-1/2	AAF811BT-8D AAF811T-8CS	2 2	Landing gear down LH blkd union to hose
13	AAF43D2474-6-154	2	Hose Assembly				
14	5204913-43	1	1/2 OD x .049 52SO	18	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up L H tee to (45°) elbow
15	5204914-54	1	1/4 OD x .032 52SO	55-1/4	AAF811BT-4D AAF811T-4CS	2 2	Landing gear down gage blkd elbow to gage
16	5204914-29	1	1/4 OD x .032 52SO	23-1/2	AAF811BT-4D AAF811T-4CS	2 2	Landing down gage tee to blkd elbow
17	5204914-31	1	1/2 OD x .049 52SO	6-1/4	AAF811BT-8D AAF811T-8CS	2 2	Landing down valve to tee
18	5204914-32	1	1/2 OD x .049 52SO	17-3/8	AAF811BT-8D AAF811T-8CS	2 2	Landing gear down tee to union
19	5204914-33	1	1/2 OD x .049 52SO	24	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up valve to union
20	5204914-34	1	1/2 OD x .049 52SO	118	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up union to blkd union
21	5204914-20	1	1/2 OD x .049 52SO	115-1/2	AAF811BT-8D AAF811T-8CS	2 2	Landing gear down union to blkd union
22	5204913-29	1	1/2 OD x .049 52SO	115	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up LH tee to blkd union
23	5204913-30	1	1/2 OD x .049 52SO	111	AAF811BT-8D AAF811T-8CS	2 2	Landing gear down LH tee to blkd union
24	5204913-44	1	1/2 OD x .049 52SO	16	AAF811BT-8D AAF811T-8CS	2 2	Landing gear up RH tee to (45°) elbow

KEY TO FIGURE 640—C-47 and C-47A Airplanes

(Douglas Dwg. Nos. 5110513, 5141942, 5110553, 5141943, 5110568, and 5203619)

Item	*Part No.*	*Part Name*	*No. Req*
A	8-8-4JTD	Parker Tee	1
B	6-6-4JTD	Parker Tee	1
C		For parts within this area refer to figure 635	(Ref)
D	109-5	Aeroquip Self-Sealing Coupling	4
	or		
	UD-120-5	American Screw Products Coupling	4
	1204823	Plate	4
	2143161	Bolt	4
	AF 40B887-016-C-024-20	Gasket	8
E	6FT	Parker Connector (Some Airplanes)	4
	1203210	Coupling (Some Airplanes)	4
F	3115-1HT-6D	Parker Blkd Coupling	2
	11-1039-1-5D	Lock Nut	2
G	3115-1HT-6D	Parker Coupling	2
	11-1039-1-5D	Lock Nut	2
H	AF811HT-6D	Union	2
I	6FT	Parker Connector (Some Airplanes)	2
	or		
	1203212	Coupling (Some Airplanes)	2
J	1203211	Adapter (Some Airplanes)	2
K	6-CT-S	Parker Elbow	2
L	1114352	Fitting	2
	1031662-6S	Nut	2
M	8-8-4-6KST-D	Parker Cross	1
N	8CT-S	Parker Elbow	1
O	6CT-S	Parker Elbow	2
P	5143257	Brake Control Valve	1
	AN912-2	(See figure 408)	1
	or		
	5007340-500	Brake Control Valve	1
Q	6-6-4-4 KTD	Parker Cross (Side opening must point down)	1
	CA-120-4	Cap (American Screw Product)	1
R		Rudder—Brake Pedals (See figure 413)	(Ref)
S	3115-1HT-8D	Parker Coupling	1
	11-1039-1-10D	Lock Nut	1
T	3115-1HT-6D	Parker Coupling	3
	11-1039-1-5D	Lock Nut	3
U	AF811-JT-6-6-4D	Tee (With 5112589-67 Line)	1
	or		
	AF811-HT-6	Union (With 5112589-1 Line)	1
V	AF811-JT-8-8-4D	Tee (With 5112589-68 Line)	1
	or		
	AF811-8	Union (With 5112589-13 Line)	1

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5112589-7	1	3/8 OD x .042 52SO	49	AF811BT-6D AF811T-CS	2 2	LH brake operating line elbow in valve to union
2	5112589-10	1	1/2 OD x .042 52SO	34	AF811BT-8D AF811T-8CS	2 2	Brake return line—tee to tee
3	5112589-5	1	3/8 OD x .042 52SO	53	AF811BT-6D AF811T-6CS	2 2	RH brake operating line—elbow in valve to blkd union
4	5112589-4	1	3/8 OD x .042 52SO	4-1/2	AF811BT-6D AF811T-6CS	2 2	Brake pressure line check valve to tee



13
J
K
15
H
14
G
L
K
J
13
I
12
11
10
H
9
G
F
8
E
D
C
7
B
6
A
5
4
3
2
1
I
12
L
8
23
E
25
D
24
23
22
21
20
V
19
U
18
17
T
S
R
Q
P
O
N
16
M

Figure 640—Brake Hydraulic System (Lines and Fittings)

KEY TO FIGURE 640—C-47 and C-47A Airplanes—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
5	5112589-3	1	3/8 OD x .042 52SO	31-1/2	AF811BT-6D AF811T-6CS	2 2	Brake pressure line tee to tee
6	5112589-11	1	1/2 OD x .042 52SO	14-1/2	AF811BT-6D AF811T-6CS	2 2	Brake return line—tee to blkd union
7	5112589-2	1	3/8 OD x .042 52SO	9-1/2	AF811BT-6D AF811T-6CS	2 2	Brake pressure line blkd union to tee
8	4116679-1	2	3/8 OD x .035 52SO	31	6T-S 6BT-S	2 2	Brake operating line—Y-fitting to hose connector
9	5112588-2	1	3/8 OD x .042 52SO	32	AF811BT-6D AF811T-6CS	2 2	RH brake operating line —blkd union to union
10	5112588-3	1	3/8 OD x .042 52SO	64	AF811BT-6D AF811T-6CS	2 2	RH brake operating line —union to hose con.
11	5112588-1	1	3/8 OD x .042 52SO	65	AF811BT-6D AF811T-6CS	2 2	RH brake operating line —blkd union to union
12	4116679-2	2	3/8 OD x .035 52SO	14-1/4	6T-S 6BT-S	2 2	Brake operating line—hose to Y-fitting
13	AAF43D2474-6-240	2	Hose Assembly (Some Airplanes)				
	or						
	2116966	2	Hose Assembly (Some Airplanes)				
14	5112588-5	1	3/8 OD x .042 52SO	34-3/4	AF811BT-6D AF811T-6CS	2 2	LH brake operating line —blkd union to union
15	5112588-6	1	3/8 OD x .042 52SO	65	AF811BT-6D AF811T-6CS	2 2	LH brake operating line union to hose connector
16	5112589-9	1	1/2 OD x .042 52SO	6-1/2	AF811BT-8D AF811T-8CS	2 2	Brake return line elbow in valve to tee
17	5112589-12	1	1/2 OD x .042 52SO	37-3/4	AF811BT-8D AF811T-8CS	2 2	Brake return line blkd union to union or (tee)
18	5112589-54	1	3/8 OD x .042 52SO	42-1/4	AF811BT-6D AF811T-6CS	2 2	Brake pressure line—blkd union to union or (tee)
19	5112589-67	1	3/8 OD x .042 52SO	11-1/2	AF811BT-6D AF811T-6CS	2 2	Brake pressure line— —tee on panel to tee
	or						
	5112589-1	1	3/8 OD x .042 52SO	12	AF811BT-6D AF811T-6CS	2 2	Brake pressure line—tee on panel to union
20	5112589-68	(Ref)	1/2 OD x .042 52SO	58	AF811BT-8D AF811T-8CS	2 2	Brake return line tee on reservoir to tee
	or						
	5112589-13	(Ref)	1/2 OD x .042 52SO	59	AF811BT-8D AF811T-8CS	2 2	Brake return line tee on reservoir to union
21	5112589-8	1	3/8 OD x .042 52SO	144-1/4	AF811BT-6D AF811T-6CS	2 2	LH brake operating line blkd union to union
22	5112589-6	1	3/8 OD x .042 52SO	144	AF811BT-6D AF811T-6CS	2 2	RH brake operating line blkd union to union
23	4116679-3	2	3/8 OD x .035 52SO	31	6T-S 6BT-S	2 2	Brake operating line Y-fitting to hose con.
24	5112588-4	1	3/8 OD x .042 52SO	119-1/2	AF811BT-6D AF811T-6CS	2 2	LH brake operating line —blkd union to blkd union
25	1202670	4	Hose Assembly (Some Airplanes)				43D2474-5-10 hose assembly with 4-1/2 wide x 7 long leather sleeve cemented on hose
	or						
	1116960	4	Hose Assembly (Some Airplanes)				

KEY TO FIGURE 640—C-47B Airplanes

Item	*Part No.*	*Part Name*	*No. Req*
A	1601-8-8-4-4KTD	Parker Cross	1
B	1601-6-6-4-4KTD	Parker Cross	1
C		For parts within this area refer to 635A	(Ref)
D	163-5	Aeroquip Self-Sealing Coupling	4
	or		
	UD-120-5	American Screw Products Coupling	4
E	1203210	Coupling	4
F	3115-2HT-6D	Parker Coupling	2
	11-1039-1-5D	Locknut	2
G	3115-1HT-6D	Parker Coupling	2
	11-1039-1-5D	Locknut	2
H	AF811HT-6D	Union	2
I	1203212	Coupling	2
J	1203211	Adaptor	2
K	6-CT-S	Parker Elbow	2
L	1114352	Fitting	2
	1031662-6S	Nut	2
M	8-8-4-6KST-D	Parker Cross	1
N	8CT-S	Parker Elbow	1
O	6CT-S	Parker Elbow	2
P	5143257	Brake Control Valve (See figure 408)	1
Q	6-6-4-4KTD	Parker Cross (Side opening must point down)	1
	CA-120-4	Cap (American Screw Product)	1
R		Rudder—Brake Pedals (See figure 413)	(Ref)
S	3115-1HT-8D	Parker Coupling	1
	11-1039-1-10D	Locknut	1
T	3115-1HT-6D	Parker Coupling	3
	11-1039-1-5D	Parker Locknut	3
U	AAF811-HT-6D	Union	1
V	AAF811-HT-8D	Union	1

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5204914-5	1	3/8 OD x .042 52SO	53	AAF811BT-6D AAF811T-6CS	2 2	RH brake pressure line —valve to blkd union in RH Tunnel
2	5204914-10	1	1/2 OD x .042 52SO	34	AAF811BT-8D AAF811T-8CS	2 2	Brake return cross to tee
3	5204914-7	1	3/8 OD x .042 52SO	49	AAF811BT-6D AAF811T-6CS	2 2	LH brake pressure line —valve to blkd union in RH tunnel
4	5204914-4	1	3/8 OD x .042 52SO	5-1/8	AAF811BT-6D AAF811T-6CS	2 2	Brake supply tee to check at brake control valve
5	5204914-3	1	3/8 OD x .042 52SO	31-1/2	AAF811BT-6D AAF811T-6CS	2 2	Brake supply cross to tee
6	5204914-11	1	1/2 OD x .042 52SO	14-1/2	AAF811BT-8D AAF811T-8CS	2 2	Brake return cross to blkd union
7	5204914-2	1	3/8 OD x .042 52SO	9-1/2	AAF811BT-6D AAF811T-6CS	2 2	Brake supply blkd union to cross
8	4116679-3	2	3/8 OD x .035 52SO	31	6T-S Parker 6BT-S Parker	2 2	Brake operating line Y-fitting to hose connector
9	5204913-2	1	3/8 OD x .042 52SO	29	AAF811BT-6D AAF811T-6CS	2 2	RH brake pressure blkd union to union

KEY TO FIGURE 640—C-47B Airplanes—Continued

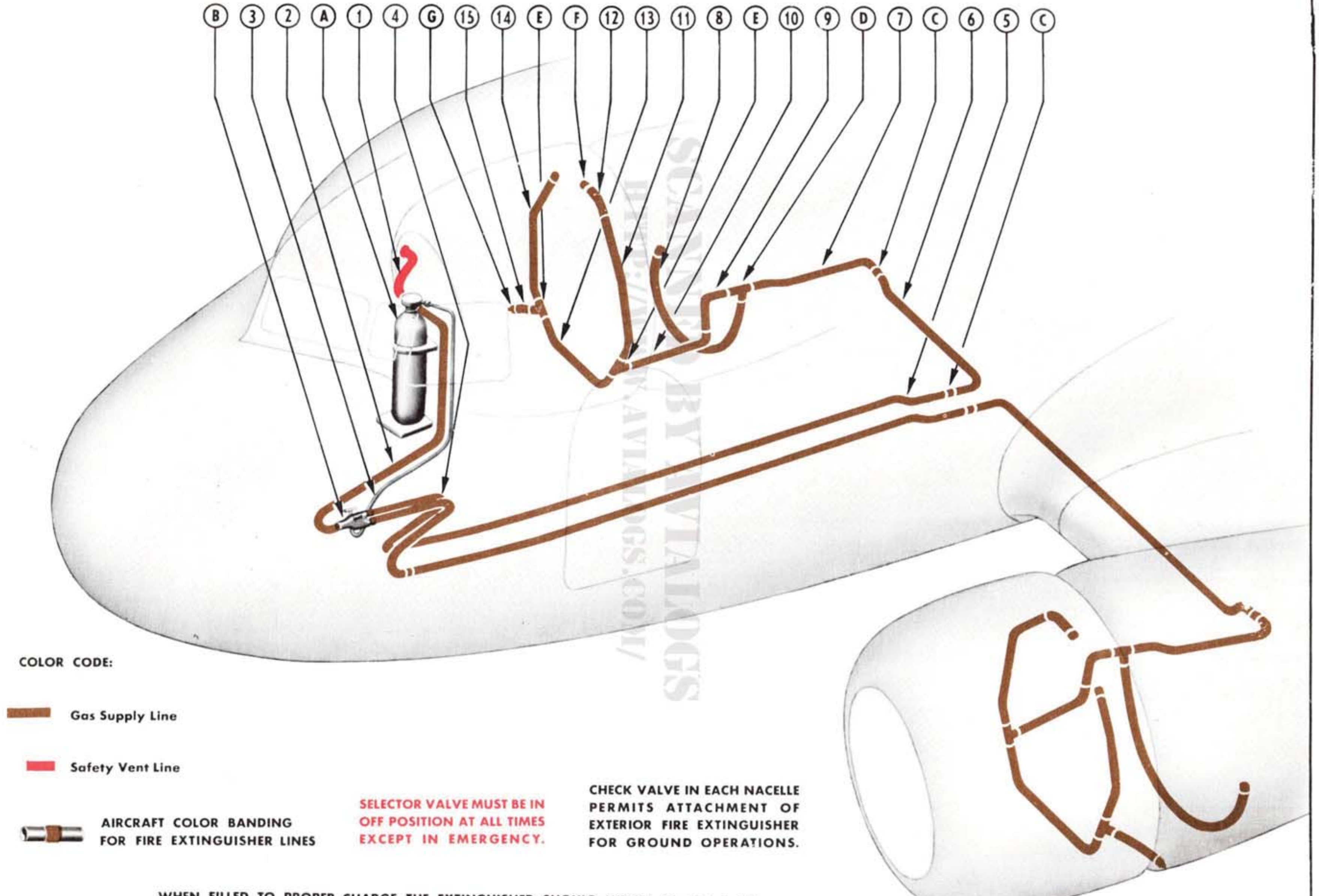
Item	Part No.	No. Req	Size and Material	Lgth	Fittings	Ftgs per Line	Remarks
10	5204913-3	1	3/8 OD x .042 52SO	64	AAF811BT-6D AAF811T-6CS	2 2	RH brake pressure union to hose adaptor
11	5204913-1	1	3/8 OD x .042 52SO	65	AAF811BT-6D AAF811T-6CS	2 2	RH brake pressure blkd union to blkd union
12	4116679-2	2	3/8 OD x .035 52SO	14-1/4	6T-S Parker 6BT-S Parker	2 2	Brake operating line hose to Y-fitting
13	AAF43D2474-6-240	2	Hose Assembly (C-47B Airplanes)				Adaptor to coupling on rear brace strut
14	5204913-5	1	3/8 OD x .042 52SO	28	AAF811BT-6D AAF811T-6CS	2 2	LH brake pressure blkd union to union
15	5204913-6	1	3/8 OD x .042 52SO	65	AAF811BT-6D AAF811T-6CS	2 2	LH brake pressure union to hose adaptor
16	5204914-9	1	1/2 OD x .042 52SO	6-1/2	AAF811BT-8D AAF811T-8CS	2 2	Brake return valve to tee
17	5204914-12	1	1/2 OD x .042 52SO	37-3/4	AAF811BT-8D AAF811T-8CS	2 2	Brake return blkd union to union
18	5204914-53	1	3/8 OD x .042 52SO	42-1/2	AAF811BT-6D AAF811T-6CS	2 2	Brake supply union to blkd union
21	5204914-8	1	3/8 OD x .042 52SO	145	AAF811BT-6D AAF811T-6CS	2 2	LH brake pressure line blkd union to blkd union
22	5204914-6	1	3/8 OD x .042 52SO	145	AAF811BT-6D AAF811T-6CS	2 2	RH brake pressure line blkd union to blkd union
23	4116679-1	2	3/8 OD x .035 52SO	31	6T-S Parker 6BT-S Parker	2 2	Brake operating line Y-fitting to hose connector
24	5204913-4	1	3/8 OD x .042 52SO	119-1/2	AAF811BT-6D AAF811T-6CS	2 2	LH brake pressure blkd union to blkd union
25	1202670	4	Hose Assembly				Coupling on strut to coupling on brake drum

KEY TO FIGURE 641

(Douglas Drawing Nos. 5110554, 5110517, 5110581)

Ref	Part No.	Part Name	No. Req
A	24998	Lux Cylinder Assembly	1
B	62038	Lux Panel Assembly	1
C	3115-1HT-7D	Parker Bulkhead Union	4
		Lock Nut	4
	11-1034-1-7D	Union (at Opposite End of Line)	2
D	811RT-7	Tee	2
E	811JT8	Tee	4
F	1119660	Nipple	2
G	11-440-40	Parker Check Valve	2

Line No.	Douglas Dwg No.
5112321	5110554
5112317	5110517
5112322	5110581
2117019	5110581


B
3
2
A
1
4
G
15
14
E
F
12
13
11
8
E
10
9
D
7
C
6
5
C
COLOR CODE:
Gas Supply Line
Safety Vent Line
AIRCRAFT COLOR BANDING FOR FIRE EXTINGUISHER LINES

SELECTOR VALVE MUST BE IN OFF POSITION AT ALL TIMES EXCEPT IN EMERGENCY.

CHECK VALVE IN EACH NACELLE PERMITS ATTACHMENT OF EXTERIOR FIRE EXTINGUISHER FOR GROUND OPERATIONS.

WHEN FILLED TO PROPER CHARGE THE EXTINGUISHER SHOULD WEIGH 18 LBS. 6 OZ.

Figure 641—Engine Fire Extinguisher System (Lines and Fittings)

KEY TO FIGURE 641—Continued

Ref No.	*Part No.*	*No. Req Apl*	*Material*	*Length*	*Location*	*Fittings*
1	5112321-7	1	52SO 1/4 x .035 OD	8-3/8	Cylinder to atmosphere	Lux 20863 811BT4D 811BT4CS 811FT4
2	5112321-5	1	52SO 7/16 x .035 OD	55-1/2	Cylinder to selector valve	Parker 7B Lux 19016
3	5112321-6	1	52SO 1/40 x .035 OD	51	Cable conduit-cylinder to selector valve	AF811BT4D AF811T4CS AF810B4D AF811FT4
4	5112321-4	1	52SO 7/16 x .035 OD	25	Selector valve to union (RH)	Parker 7-B 7-BT-D 7-T-CS
	5112321-16	1	52SO 7/16 x .035 OD	25	Selector valve to union (LH)	Parker 7-B 7-BT-D 7-T-CS
5	5112321-3	1	52SO 7/16 x .035 OD	131	Union to union (RH)	Parker 7-BT-D
	5112321-1	1	52SO 7/16 x .035 OD	131	Union to union (LH)	Parker 7-BT-CS
6	5112317-2	1	52SO 7/16 x .035 OD	60-3/4	Fuselage connection plate to cantilever rib (RH)	Parker 7-BT-D 7-T-CS
	5112317-1	1	52SO 7/16 x .035 OD	60-3/4	Fuselage connection plate to cantilever rib (LH)	Parker 7-BT-D 7-T-CS
7	5112317-4	1	52SO 7/16 x .035 OD	33	Cantilever rib union to fire wall (RH)	Parker 7-BT-D Parker 7-T-CS
	5112317-3	1	52SO 7/16 x .035 OD	33	Cantilever rib union to fire wall (LH)	Parker 7-BT-D Parker 7-T-CS
8	5112317-6	1	52SO 7/16 x .035 OD	53-1/2	Tee to plug (RH)	Parker 7-BT-D Parker 7-T-CS
	5112317-5	1	52SO 7/16 x .035 OD	53-1/2	Tee to plug (LH)	Parker 7-BT-D Parker 7-T-CS 7PNT-D (plug)
9	2117019	2	Titeflex std double fine braid hose 3/8 ID	7-3/4	Fire wall to line (RH)	Titeflex E-6-19DB
10	5112322-6	1	Corr-resist. steel 1/2 x .035 OD	24-1/2	Flexible hose to tee (RH)	811T8CS 811BT8SS
	5112322-1	1	Corr-resist. steel 1/2 x .035 OD	24-1/2	Flexible hose to tee (LH)	811T8CS 811BT8SS
11	5112322-9	1	Corr-resist. steel 1/2 x .035 OD	22-1/2	Tee to carburetor hose (RH)	811T8CS 811BT8SS
	5112322-2	1	Corr-resist. steel 1/2 x .035 OD	22-1/2	Tee to carburetor hose (LH)	811T8CS 811BT8SS
12	2117019	2	Titeflex std double fine braid hose 3/8 ID	7-3/4	Line to carburetor fitting (RH)	Titeflex E6-19DB 811GT8
13	5112322-8	1	Corr-resist. steel 1/2 x .035 OD	22-1/2	Tee to tee (RH)	811BT8SS 811T-8CS
	5112322-3	1	Corr-resist. steel 1/2 x .035 OD	22-1/2	Tee to tee (LH)	811BT8SS 811T-8CS
14	5112322-7	1	Corr-resist. steel 1/2 x .035 OD	34	Tee to plug (RH)	811BT8SS 811T-8CS
	5112322-4	1	Corr-resist. steel 1/2 x .035 OD	34	Tee to plug (LH)	811BT8SS 811T-8CS 8 PNT (plug)

KEY TO FIGURE 641—Continued

Ref No.	*Part No.*	*No. Req Apl*	*Material*	*Length*	*Location*	*Fittings*
15	5112322-10	1	Corr-resist. steel 1/2 x .035 OD	6-3/4	Tee to check valve (RH)	811BT8SS 811T-8CS F-3351 (spud)
	5112322-5	1	Corr-resist. steel 1/2 x .035 OD	6-3/4	Tee to check valve (LH)	811BT8SS 811T-8CS F-3351 (spud)

KEY TO FIGURE 642

Item	*Part No.*	*No. Req*	*Size and Material*	*Length*	*Fittings*	*Ftgs per Line*	*Remarks*
1	5115399-1	1	1-1/2 OD x .025 wall corr-resistor steel tube	57-1/2 in.			From 2114630 line to 2117583 line assembly
2	2114630	1	Corr-resistor steel tube				Weld assembly (steam trap to 2115835-2 line)
3	5115399-23	1	1/2 OD x .049 wall alum.-alloy tube	30-1/2 in.			From−3 line to 2115835-4 line
4	2115835-2	1	1-1/2 OD x .025 corr-resistor steel tube	39 in.			Part of 2115835 assembly
5	2115835-4	1	1/2 OD x .049	38-1/2 in.			Part of 2115835
6	2115063-4	1	1/2 OD x .035 alum.-alloy 52SO	23-1/2 in.			Part of 2115063 assembly
7	4115338-2	1	1-1/2 OD x .025 corr-resistor steel tube	47 in.			Part of 4115338-12 tube assembly
8	5113789-3	1	1-1/2 OD x .025 corr-resistor steel tube	43-1/2 in.			Radiator to 5113789-11 line
9	5113789-7	1					Air eliminator to steam trap on some airplanes or 5113789-23 press. gage to air eliminator
10	5113789-11	1	1-1/2 OD x .025 corr-resistor steel tube	51-1/2 in.			
11	5113789-1	1	1/2 OD x .028 alum.-alloy tube	12-3/4 in.			Radiator to air eliminator or pressure gage line
12	5113789-5	1					Steam trap or air eliminator to 4117381-4 line or 2142284 tube assem. (steam trap or air eliminator to 4117381-4 line)
13	5115399-19	1	3/8 OD x .049 wall alum.-alloy tube	8 in.	AF811BT6D AF811T6CS	2 2	Tank to steam pressure regulator
14	5115399-21	1	3/8 OD x .049 wall alum.-alloy tube	7-1/2 in.	AF811BT6D AF811T6CS	2 2	Steam line to pressure regulator
15	5115399-9	1	1/2 OD x .025 wall corr-resistor steel tube	5-1/2 in.	AF811BT8NS AF811T8NS	2 2	Tee to radiator
16	5115399-13	1	1/2 OD x .049 wall alum.-alloy tube	19 in.	AF811T8CS	2	From −15 line to tee
17	5115399-15	1	1/2 OD x .049 wall alum.-alloy tube	31-1/2 in.	AF811BT8D AF811T8CS	2 2	From −17 line to −13 line

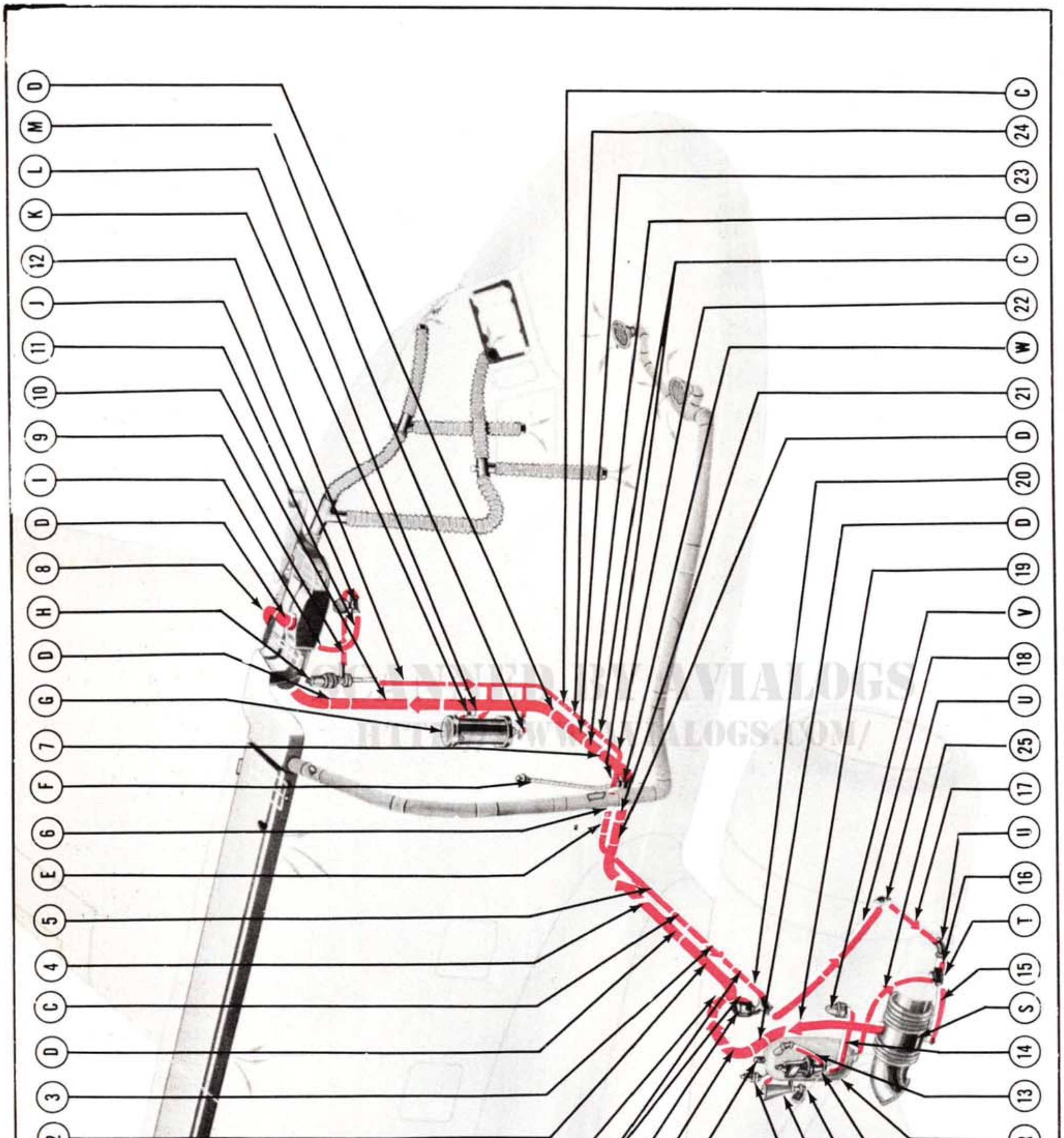

D
M
L
K
12
J
11
10
9
I
D
8
H
D
G
7
F
6
E
5
4
C
D
3
2
D
C
B
1
A
C
24
23
D
C
22
W
21
D
20
D
19
V
18
U
25
17
U
16
T
15
S
14
13
R
Q
P
O
N

Figure 642—Steam Heating and Ventilating System (Lines and Fittings)

KEY TO FIGURE 642—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Length*	*Fittings*	*Ftgs per Line*	*Remarks*
18	5115399-17	1	1/2 OD x .049 wall alum.-alloy tube	44-1/2 in.	AF811BT8D AF811T8CS	1 1	Steam trap to −15 line
19	2117583	1	1-1/2 OD x .025 wall corr-resistor steel tube	35 in.			Boiler to 5115399-1 line
20	5115399-3	1	1/2 OD x .049 wall alum.-alloy tube	8-1/4 in.	AF811BT8D AF811T8CS	1 1	Steam trap tee to −23 line
21	2115063-2	1	1-1/2 OD x .025 corr-resistor steel	22-1/2 in.			Part of 2115063-12 assembly
22	4115338-4	1	1/2 OD x .035 alum.-alloy 52SO	44-3/4 in.			Part of 4115338 tube assembly
23	4117381-2	1	1-1/2 OD x .025 corr-resistor steel tube	29 in.			Part of 4117381 assembly
24	4117381-4	1	1/2 OD x .035 alum.-alloy 52SO	28-1/2 in.			Part of 4117381 assembly
25	5115399-11	1	1/2 OD x .049 wall alum.-alloy tube	14 in.	AF811BT8D AF811T8CS	2 2	Water tank to tee

Item	*Part No.*	*Part Name*	*No. Req per Apl*
A	AN913-3	Plug	1
		or (on Some Airplanes)	
	AW-2-1/2-21	U.S. Pressure Gage	1
	AD-2216	Dial	1
B	2115519	Steam Trap	1
	AF895-82	Reducing Bushing	1
	AF811ST-8D	Tee	1
	AF895-3	Elbow	1
	AF850-6	Elbow	1
C	AF882-8-9	Hose	6
D	AF882-24-14	Hose	8
E	AF882-8-12	Hose	1
F	2116481	Control Assembly	1
	AN392-11	Pin	1
G	5141277	Tank—Filler	1
		1/4 in. Street Elbow	1
		1/4 in. Pipe Nipple (Close)	1
	No. 50	Walworth Globe Valve (1/4 in.)	1
	AF884-8-9	Hose	1
	1142282	Nipple	1
	No. 58	Walworth Valve (3/8 in.)	1
		3/8 in. Pipe Nipple (Close)	1
	1142282-4	Nipple	1
	AF884-8-9	Hose	1
H	2115519	Steam Trap	1
	AF811CT 45° 8D	Elbow	1
	AF811CT-8D	Elbow or	1
	1115567	Air Eliminator	1
	2142264	"T" Fitting Hose	1
	AN884-8-12	Hose	2
I	AF811CT-8D	Elbow	1
J	1115567	Air eliminator	1
	AW-2-1/2-21	Pressure Gage	1
	AD-2216	Dial	1
	8-8-4-OT-D	Tee (Parker)	1
K	1/4 Street Ell		1
	1/4 Close Pipe	Nipple Coml	1

KEY TO FIGURE 642—Continued

Item	*Part No.*	*Part Name*	*No. Req Per Apl*
L	No. 50	Walworth Globe Valve (1/4)	1
	1142282-2	Nipple	1
	AF884-8-9	Hose	1
M	AF884-8-9	Hose	1
	1142282-4	Nipple	1
	No. 59, 3/8	Walworth Valve	1
	3/8	Close Pipe Nipple	1
N	1115567	Air Eliminator	1
		4-4-CD-45°	1
		1/4 in. P.T. Elbow (Parker)	1
O	2106273	Funnel	1
		on some airplanes:	
	3152-9-3/8D	Coupling (Parker)	1
	3152-7-3/8D	Long Nipple (Parker)	1
P	No. 59	3/8 in. Walworth Valve	1
Q	4115529	Steam Pressure Regulator	1
	AF811-FT-6	Nipple	2
R	4113354	Tank Assembly	1
	AF811CT-6D	Elbow	1
	AF811CT 45°-80	Elbow	1
S	5117846	Boiler	1
	8-6-8MRT	Tee (Parker)	1
	AF771-2	Drain Cock	1
	144328-2C	Gasket	1
T	AF811JT-8D	Tee	1
U	3115-2ET-8D	Bulkhead Elbow—Parker	2
	11-1039-1-10D	Lock Nut (Parker)	2
	No. 8 Fig. 3224-B-D	Elbow (Parker)	2
V	1105-45	1/2 in. Pressure Relief Valve	1
	AF895-4	Street Elbow (Roberts)	1
W	2119243	Valve Assembly	1
–	~~144~~328-2C	Gasket	2

KEY TO FIGURES 643 and 645

Lines (Banding—Light Blue and Light Green)

Item	*Part No.*	*No. Req*	*Size*	*Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
1	1116018-2	6	5/8 ID	Rubber	17			Hoses (inboard shoe connectors)
2	1116018-1	6	5/8 ID	Rubber	13			Hoses (outboard shoe connectors)
3	5112580-1	1	5/8 OD x .042	52SO	25-1/2 and 7-1/2			RH outer wing hose to shoe (upper and lower tube lines from port 2)
4	5112580-2	1	5/8 OD x .042	52SO	27-1/2			RH outer wing hose to shoe (center tube line from port 1)
5	5112580-4	1	5/8 OD x .042	52SO	90			RH nacelle hose to outer wing hose (cont from port 2)
6	5112580-3	1	5/8 OD x .042	52SO	90			RH nacelle hose to outer wing hose (cont from port 1)
7	5112580-5	1	5/8 OD x .042	52SO	16 and 6			RH nacelle hose to shoe (upper and lower tube lines cont from port 4)
8	5112580-6	1	5/8 OD x .042	52SO	18-1/4			RH nacelle hose to shoe (center tube line cont from port 3)

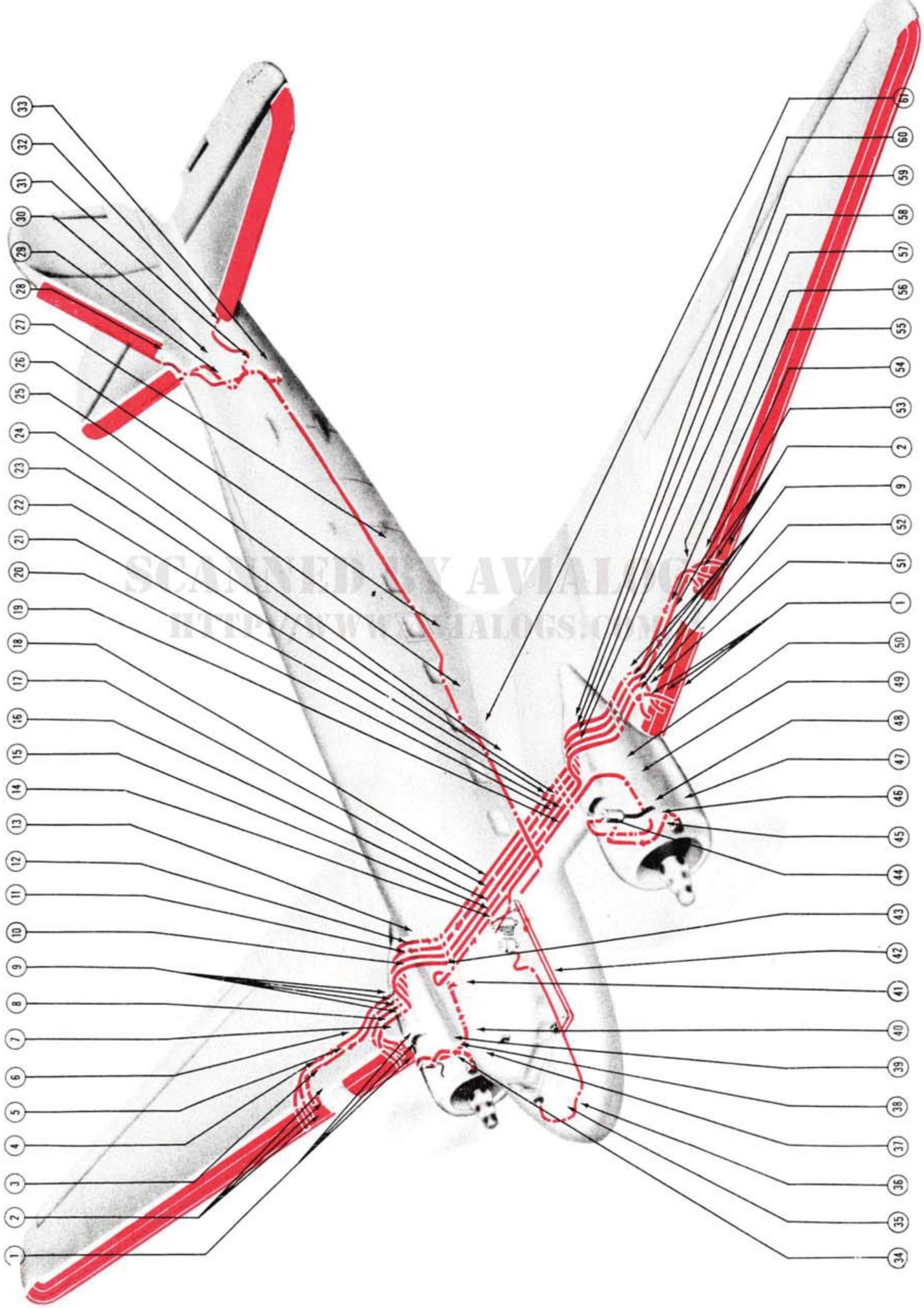

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
61
60
59
58
57
56
55
54
53
2
9
52
51
1
50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34

Figure 643—Surface De-Icer System (Lines)

KEY TO FIGURES 643 and 645—Continued

Item	*Part No.*	*No. Req*	*Size*	*Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
9	1116018-3	8	5/8 ID	Rubber	20	3117-4T-10D 11-1039-1-10D	1 1	Hoses between 2 inboard cantilever rib and 2 outbd lines and 2 inbd lines to shoe hoses on each wing
10	5112319-1	1	5/8 OD x .042	52SO	66	AF811BT-10D AF811T-10CS	2	Inboard cantilever rib to outbd cantilever rib RH (cont from port 4)
11	5112319-3	1	5/8 OD x .042	52SO	64		2	Inboard cantilever rib to outbd cantilever rib (wing RH cont from port 3)
12	5112319-5	1	5/8 OD x .042	52SO	65	AF811BT-10D AF811T-10CS	2	Inboard cantilever rib to outbd cantilever rib (wing RH cont from port 2)
13	5112319-7	1	5/8 OD x .042	52SO	63	AF811BT-10D AF811T-10CS	2	Inboard cantilever rib to outbd cantilever rib (wing RH cont port 1)
14	5112319-18	1			61	AF811BT-12D AF811T-12CS	1	Cantilever rib connector plate to hose connection RH
15	5112319-2	1	5/8 OD x .042	52SO	64-1/2	AF811BT-10D AF811T-10CS	1	Hose to inboard cantilever rib (wing surface RH cont from port 4)
16	5112319-4	1	5/8 OD x .042	52SO	61-1/2	AF811BT-10D AF811T-10CS	1	Hose to inboard cantilever rib (wing RH cont from port 3)
17	5112319-6	1	5/8 OD x .042	52SO	65	AF811BT-10D AF811T-10CS	1	Hose to inboard cantilever rib (wing RH cont from port 2)
18	5112319-8	1	5/8 OD x .042	52SO	62-1/2	AF811BT-10D AF811T-10CS	1	Hose to inboard cantilever rib (wing RH cont from port 1)
19	5112319-20	1	3/4 OD x .049	52SO	91	AF811BT-12D AF811T-12CS	1	Cantilever rib connector plate to hose connector LH
20	5112319-12	1	5/8 OD x .042	52SO	92-1/2	AF811BT-10D AF811T-10CS	1	Hose to inboard cantilever rib (wing LH cont from port 3)
21	5112319-10	1	5/8 OD x .042	52SO	88-1/2	AF811BT-10D AF811T-10CS	1	Hose to inboard cantilever rib (wing surface LH cont from port 4)
22	5112319-16	1	5/8 OD x .042	52SO	92-1/2	AF811BT-10D AF811T-10CS	1	Hose to inboard cantilever rib (wing LH cantilever from port 1)
23	5112319-14	1	5/8 OD x .042	52SO	89-1/2	AF811BT-10D AF811T-10CS	1	Hose to inboard cantilever rib (wing LH cont from port 2)
24	5112319-25	1	3/4 OD x .049	52SO	55			Hose connector to hose connector (line to tail surfaces)
25	5114880-9	1	3/4 OD x .049	52SO	34			Hose connector to hose connector (station 306 to station 340 line to tail)
26	5114880-3	1	3/4 OD x .049	52SO	107			Hose connector to hose connector (station 340 to 444 line to tail)

KEY TO FIGURES 643 and 645—Continued

Item	*Part No.*	*No. Req*	*Size*	*Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
27	5114880-4	1	3/4 OD x .049	52SO	134-1/4			Hose connector to hose connector (line to tail surfaces)
28	5114880-10	1	5/8 OD x .042	52SO	18-1/4			Fuselage surface de-icer
29	5114880-6	1	5/8 OD x .042	52SO	42-1/4			Tube assembly hose to vertical stabilizer
30	5114880-8	1	5/8 OD x .042	52SO	28-3/4			Tube assembly hose to RH horizontal stabilizer
31	4130111-6	1	5/8 OD x .042	52SO	8			Tube assembly (between tube assembly from drain cock and lines to stabilizers)
	-4		3/4 OD x .049	52SO	6			
	-2			52SO	16-3/8			
32	5114880-7	1	5/8 OD x .042	52SO	62-1/4			Tube assembly hose to LH horizontal stabilizers
33	1130500-4	1	2S 3/4 dia	Bar	1-1/8			Tube assembly (line to and from drain cock)
	-2	1	3/4 OD x .049	52SO	56-1/2			
34	5112323-6	1	1/2 OD x .042	52SO	9-1/2			Oil separator to engine case RH
35	5116836-19	1	1/4 Flexhose		17-3/8	014D 014D	2	1116892 brkt assembly (hose conn) to pressure gage (press. gage line)
36	5114880-2	1	1/4 OD x .032	52SO	48-1/4	AF811BT-4D AF811T-4CS	2	Fus tunnel forward conn plate to flex. hose conn (press. gage line)
37	5112323-3	1	3/4 OD x .049	52SO	14-1/2			Vacuum pump to hose RH
38	112323-9	1	3/4 OD x .049	52SO	28-3/4	AF811BT-12D AF811T-12CS		Oil separator to hose RH
39	5112323-7	1	3/4 OD x .049	52SO	35			Hose to oil separator RH
40	5112323-10	1	3/4 OD x .049	52SO	14			Hose to fire wall RH
41	5112319-17	1	3/4 OD x .049	52SO	28-1/2	AF811BT-12D AF811T-12CS	1	Check valve to parker union (RH nacelle)
42	5114880-1	1	1/4 OD x .032	52SO	150	AF811BT-4D AF811T-4CS	2	Fus aft conn plate to fus tunnel forward conn plate (pressure gage line)
43	5112319-35	1			24-1/2	AF811BT-12D AF811T-12CS	2	Parker union to cantilever rib (RH nacelle)
44	5112323-4	1	3/4 OD x .049	52SO	27	AF811BT-12D AF811T-12CS	1	Oil separator to hose LH
45	5112323-2	1	3/4 OD x .049	52SO	44-1/2			Hose to oil separator LH
46	5112323-5	1	3/4 OD x .049	52SO	21			Hose to fire wall LH
47	5112323-1	1	3/4 OD x .049	52SO	8			Vacuum pump to hose LH
48	5112323-8	1	1/2 OD x .042	52SO	8			Oil separator to engine case LH
49	5112319-19	1	3/4 OD x .049	52SO	30-1/2	AF811BT-12D AF811T-12CS	1	Fire wall to check valve (LH nacelle)
50	5112319-36	1	3/4 OD x .049	52SO	18	AF811BT-12D AF811T-12CS	1	Check valve to cantilever rib (LH nacelle)
51	5112580-7	1	5/8 OD x .042	52SO	16-1/2 and 6			LH nacelle hose to hose (upper and lower tube lines cont from port 4) "Y"
52	5112580-8	1	5/8 OD x .042	52SO	17-3/4			LH nacelle hose to shoe (center tube line cont from port 3)

KEY TO FIGURES 643 and 645—Continued

Item	*Part No.*	*No. Req*	*Size*	*Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
53	5112580-10	1	5/8 OD x .042	52SO	90			LH nacelle hose to outer wing hose (cont from port 2)
54	5112580-12	1	5/8 OD x .042	52SO	27 and 7-1/2			LH outer wing hose to hose (upper and lower tube lines cont from port 2) "Y"
55	5112580-9	1	5/8 OD x .042	52SO	90			LH nacelle hose to outer wing hose (cont from port 1)
56	5112580-11	1	5/8 OD x .042	52SO	28-1/2			LH outer wing hose to shoe (center tube line cont from port 1)
57	5112319-9	1	5/8 OD x .042	52SO	66	AF811BT-10D AF811T-10CS	2	Inboard cantilever rib to outboard cantilever rib LH (cont from port 4)
58	5112319-11	1	5/8 OD x .042	52SO	63-1/2			Inboard cantilever rib to outbd cantilever rib (wing LH cont from port 3)
59	5112319-13	1	5/8 OD x .042	52SO	65	AF811BT-10D AF811T-10CS	2	Inboard cantilever rib to outbd cantilever rib (wing LH cont from port 2)
60	5112319-15	1	5/8 OD x .042	52SO	64	AF811BT-10D AF811T-10CS	2	Inboard cantilever rib to outbd cantilever rib (wing LH cont port 1)
61	5112319-37	1	3/4 OD x .049	52SO	19			Hose conn to hose conn (line to tail surfaces)
62	5112319-27	1	3/4 OD x .049	52SO	25	AF811BT-12D AF811T-12CS	2	Distributor valve to air filter
63	5112319-26	1	3/4 OD x .049	52SO	17-1/2	12-8FT AC811CT-12	1 1	Air filter to distributor valve
64	5112319-32	1	5/8 OD x .049	52SO	11	AF811BT-12D AF811T-12CS	1	Distributor valve to nose Y (tube assembly) "OFF" overboard line (vent line)
65	5112319-30	1	5/8 OD x .042	52SO	6	AF811BT-10D AF811T-10CS	1	No. 4 part of distributor valve to hose conn (wing surface)
66	5112319-23	1	3/4 OD x .049	52SO	11-1/4	AF811BT-12D AF811T-12CS	1	Distributor valve to hose conn (line to tail surfaces)
67	2115662	4	5/8 OD x .042	52SO	28-1/2	AF57-187-3	3	Tee assembly (lines to 1-2-3-4 de-icer shoes—center wing)
68	5112319-24	1	3/4 OD x .049	52SO	34			Hose conn to hose conn (line to tail surfaces)
69	5112319-21	1	1/4 OD x .035	52SO	16-3/8	AF811BT-4D AF811T-4CS	2	Air filter to fus aft conn plate (pressure gage line)
70	4117715	1	3/4 OD x .049	52SO	22-1/2			Tube assembly (from distributor valve line to filter drain)
71	5112319-22	1	3/4 OD x .049	52SO	19-1/2	AF811BT-12D AF811T-12CS	1	Tee to distributor valve inlet fitting
72	5112319-33	1	5/8 OD x .042	52SO	12	AF811BT-10D AF811T-10CS	2	Boot outlet in distributor valve to distributor valve tee (vent line)
73	5112319-34	1	5/8 OD x .042	52SO	23-1/2	AF811BT-10D AF811T-10CS	1	Distributor valve tee to overboard (vent line)

KEY TO FIGURES 643 and 645—Continued

Item	Part No.	No. Req	Size	Material	Lgth	Fittings	Ftgs per Line	Description
74	5112319-31	1	5/8 OD x .042	52SO	4-1/2	AF811BT-10D AF811T-10CS	1	No. 3 port of distributor valve to hose conn (wing surfaces)
75	5112319-29	1	5/8 OD x .042	52SO	10-3/4	AF811BT-10D AF811T-10CS	1	Conn from No. 2 port distributor valve to hose conn (wing surfaces)
76	5112319-28	1	5/8 OD x .042	52SO	10-1/2	AF811BT-10D AF811T-10CS	1	Distributor valve to hose conn (wing surfaces) conn from No. 1 port
77	2117567	1	3/4 OD x .049	52SO	29	AF57-187-3	3	Tee assembly (supply line —center wing)

KEY TO FIGURES 644 and 645

Item	Part No.	Part Name	No. Req
A	AF 895-3	Street Elbow	2
	AF 835-8	Nipple	2
	AF 878-8-10	Hose	2
B	2-364-3-2	Goodrich De-Icer Shoe	1
	or (6-364-3-2)	RH Outboard	
C	AF 878-8-12	Hose	2
D	2-364-2-2	Goodrich De-Icer Shoe	1
	or (6-364-2-2)	RH Inboard	
E	4116982	Oil Separator	2
F	AF 878-12-12	Hose	7
G	3117-4T-10D	Coupling Parker	8
	11-1039-1-10D	Lock Nut Parker	8
H	702-FG-4D	Auxiliary Parker Hand Valve	1
	3296-1HT-12	Parker Union	1
	AF 835-4	Nipple	1
I	3115-1HT-12D	Coupling Parker	2
	11-1039-1-19D	Lock Nut Parker	2
J	3115-1HT-10D	Coupling Parker	8
	11-1039-1-14D	Lock Nut Parker	8
K	3115-1HT-4D	Parker Coupling	3
	11-1039-1-3D	Lock Nut	3
L	AN 884-12-11	Hose	14
M	AN 771-2	Drain Cock	1
N	AN 884-10-11	Hose	16
O	2-364-4-1	Goodrich De-Icer Shoe	2
	or (6-364-4-1)	(Horizontal Stabilizer)	
P	2-364-5-1	Goodrich De-Icer Shoe	1
	or (6-364-5-1)	(Vertical Stabilizer)	
Q	207-J.A. type B-12	Engine-Driven Vacuum Pump	2
R	225-F-01	Kollsman Gage	1
S	3117-4T-12D	Parker Coupling	2
	11-1039-1-14D	Lock Nut	2
T	557-3	Eclipse Check Valve	2
U	2-364-2-1	Goodrich De-Icer Shoe	1
	or (6-364-2-1)	LH Inboard	
V	2-364-3-1	Goodrich De-Icer Shoe	1
	or (6-364-3-1)	LH Outboard	
W	12-8CT-45°	Parker Elbow	1
X	AF 811CT-12	Elbow	1
Y	1119620	Fitting	1
Z	12-8CT	Parker Elbow	1

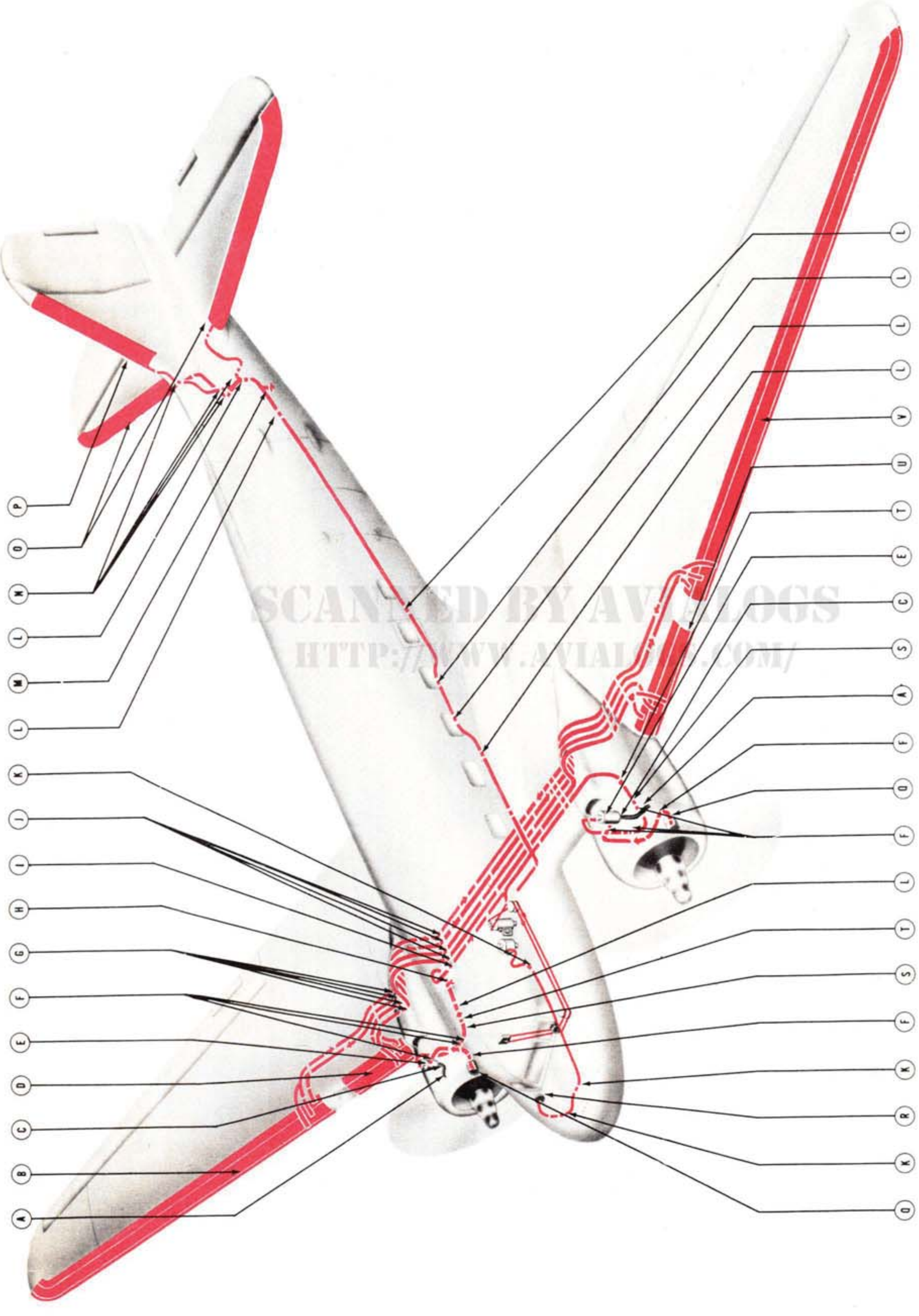

A
B
C
D
E
F
G
H
I
J
K
L
M
L
N
O
P
L
L
L
L
V
U
T
E
C
S
A
F
D
F
L
T
S
F
K
R
K
D

Figure 644—Surface De-Icer System (Fittings)

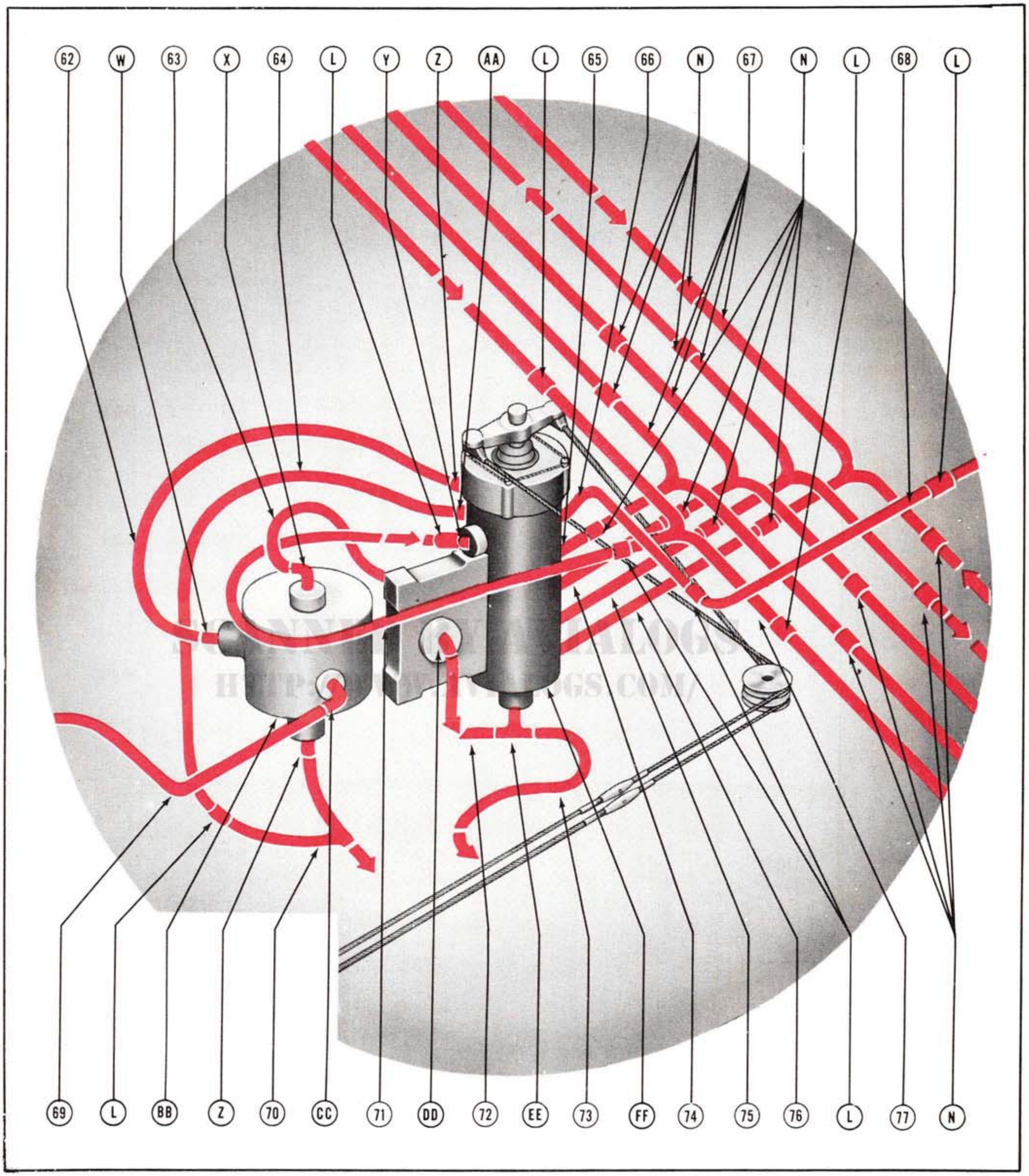

62
W
63
X
64
L
Y
Z
AA
L
65
66
N
67
N
L
68
L
69
L
BB
Z
70
CC
71
DD
72
EE
73
FF
74
75
76
L
77
N

Figure 645—Detail of Surface De-Icer Distributor Valve (Lines and Fittings)

KEY TO FIGURES 644 and 645—Continued

Item	*Part No.*	*Part Name*	*No. Req*
AA	AF 811CT8-45°-12	Elbow	2
BB	559-1	Air Filter (Eclipse Oil Separator)	1
CC	AF 811CT-4	Elbow	1
DD	AF 811FT-10	Nipple ("ON" Exhaust port)	1

KEY TO FIGURES 644 and 645—Continued

Item	*Part No*	*Part Name*	*No. Req*
EE	AF 811ST-10	Tee	1
FF	572-2	Eclipse Distributor Valve	1
	12-8FT	Parker Nipple	1
	12-8CCCT	Parker Elbow	1
	AF 811CT45°-10	Elbow	3
	AF 811CT-10	Elbow	1

KEY TO FIGURE 646

(Banding—Red and White)

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
1	2139827-6	1	1/4 OD x .035 52SO	21	AF811-T-4CS AF811-BT-4D	2 2	Tank vent to hose
2	2139829-10	1	1/4 OD x .035 soft annealed copper	36			Hose to manifold LH
	2139829-11	1	1/4 OD x .035 soft annealed copper	36			Hose to manifold RH
3	2139827-7	1	1/4 OD x .035 52SO	47-1/4			Hose to vent
4	2139829-1	1	1/4 OD x .035 52SO	52	AF811-T-4CS AF811BT-4D	2 2	Fire wall to hose RH nacelle
	2139829-2	1	1/4 OD x .035 52SO	25-1/4	AF811-T-4CS AF811-BT-4D	2 2	Fire wall to hose LH nacelle
5	2139828-3	1	1/4 OD x .035 52SO	36-1/2	AF811-T-4CS AF811-BT-4D	2 2	Nacelle panel to fire wall RH
	2139828-4	1	1/4 OD x .035 52SO	35-1/4	AF811-T-4CS AF811-BT-4D	2 2	Nacelle panel to fire wall LH
6	2139827-4	1	1/4 OD x .035 52SO	114	AF811-T-4CS AF811-BT-4D	2 2	Hose to wing panel RH
	2139827-5	1	1/4 OD x .035 52SO	113	AF811-T-4CS AF811-BT-4D	2 2	Hose to wing panel LH
7	2139828-1	1	1/4 OD x .035 52SO	64-1/4	AF811-T-4CS AF811-BT-4D	2 2	Wing panel to nacelle panel RH
	2139828-2	1	1/4 OD x .035 52SO	116-1/4	AF811-T-4CS AF811-BT-4D	2 2	Wing panel to nacelle panel LH
8	2139827-3	2	1/4 OD x .035 52SO	18	AF811-T-4CS AF811-BT-4D	2 2	Pump to hose
9	2139827-1	1	5/16 OD x .035 52SO	15-1/2	AF811-T-5CS AF811-BT-5D	2 2	Tank drain to filter
10	2139829-9	2	1/4 OD x .035 soft annealed copper	20	AN800-4	2	Manifold to hot box
11	2139829-8	2	1/4 OD x .035 soft annealed copper	10	AN800-4 AN805-4	2 2	Manifold to hot box
12	2139829-7	2	1/4 OD x .035 soft annealed copper	11-1/2	AN800-4 AN805-4	2 2	Manifold to hot box
13	2139829-6	2	1/4 OD x .035 soft annealed copper	12	AN800-4 AN805-4	2 2	Manifold to hot box
	ADDITIONAL LINES ON SOME C-47 AIRPLANES (NOT SHOWN)						
	2139829-3	1 was 2	1/4 OD x .035 52SO	39-1/2		2	Hose to tee RH

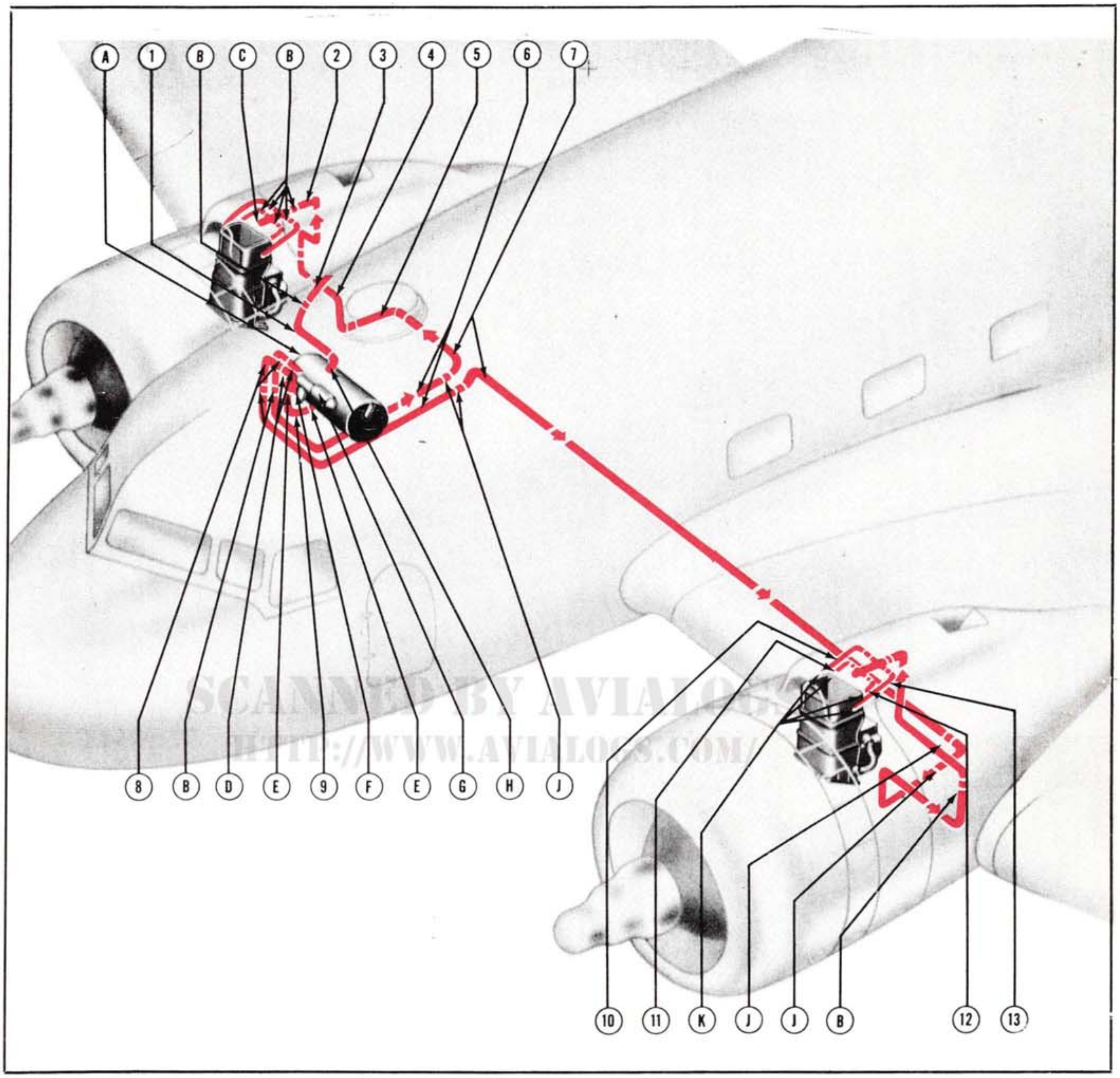


Figure 646—Carburetor Anti-Icer System (Lines and Fittings)

KEY TO FIGURE 646—Continued

Item	*Part No.*	*No. Req*	*Size and Material*	*Lgth*	*Fittings*	*Ftgs Per Line*	*Description*
	2139829-4	1 was 4	1/4 OD x .035 52SO	39-1/2		2	Hose to tee LH
	2139829-5	4	1/4 OD x .035 soft annealed copper	13		2	Tee to carburetor

Item	*Part No.*	*Part Name*	*No. Req per Apl*
A	5139830	Tank Assembly	1
	8-001	Tank	1
	AF-909-16	Plug	1

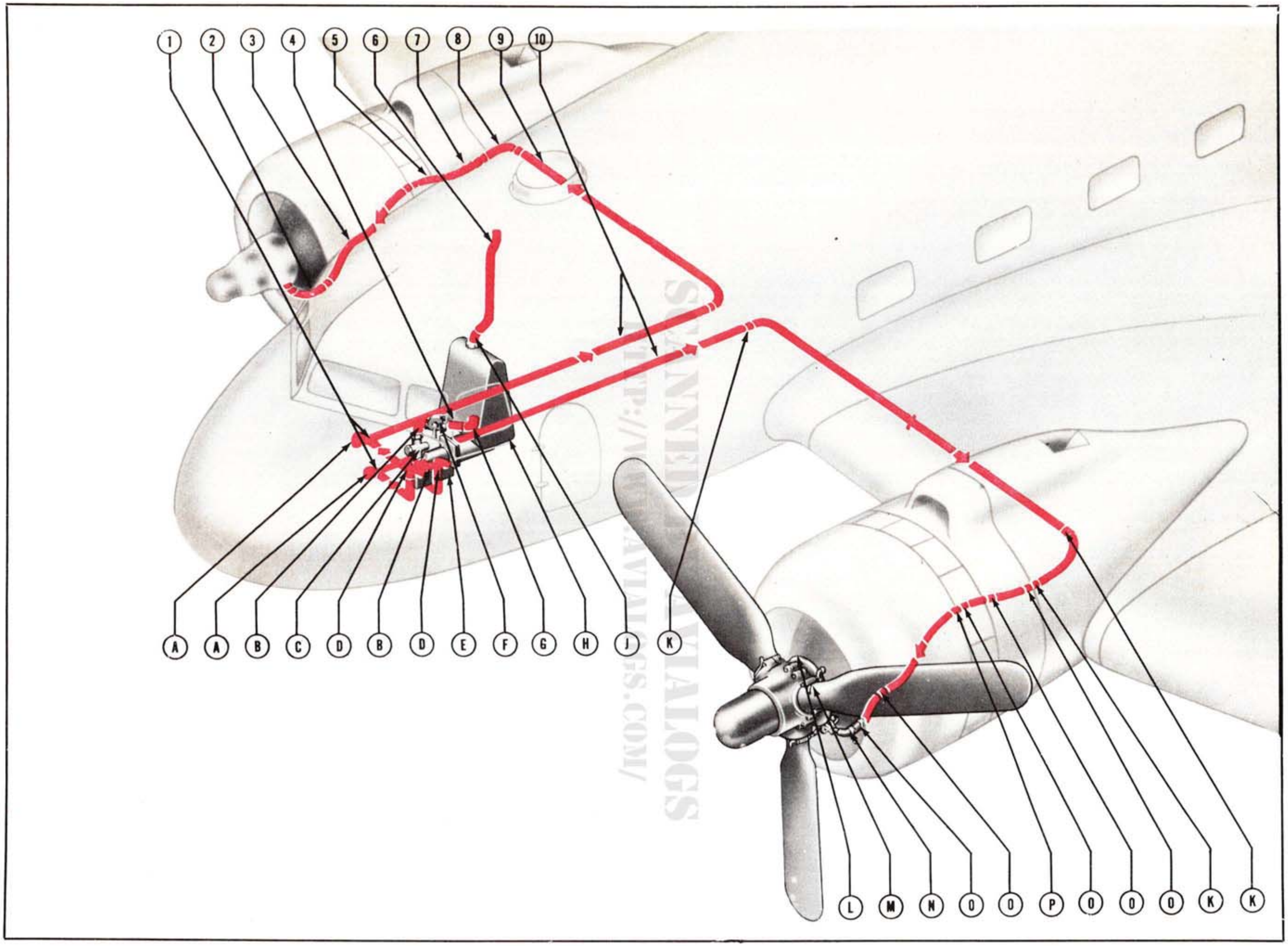

1
2
3
4
5
6
7
8
9
10
A
A
B
C
D
B
D
E
F
G
H
J
K
L
M
N
O
O
P
O
O
O
K
K

Figure 647—Propeller Anti-Icer System (Lines and Fittings)

KEY TO FIGURE 646—Continued

Item	*Part No.*	*Part Name*	*No. Req per Apl*
B	3706-4-9	Weatherhead Hose	15
C	4141852	Manifold	2
D	A-8182-2	Check Valve	2
E	AF811CT5D	Elbow	2
	AF895-90	Nipple	1
F	A7979	Adel Filter	1
G	J4-O-24D-1/8 P.T.	Adel Pump	1
H	AF811CT4D	Elbow (Tank Vent)	1
J	3115-1HT-4D	Parker Bulkhead Coupling	6
	11-1039-1-3D	Parker Lock Nut	8
K	AN4022-2	Nipple Assembly	8
	AN800-4	Cone	8
	AN805-4	Nut	8

KEY TO FIGURE 647

Item	*Part No.*	*Part Name*	*No. Req per Plane*
A	AF811HT4D	Union	2
B	AF895-1	Elbow	1
	AF895-90	Nipple	2
C	EA8-2393	Eclipse Filter (Strainer)	1
	AF895-1	Elbow	
D	AF811CT4	Elbow (Pump outlet lines)	2
E	744-6	Eclipse Pump	1
	No. 101	Weldon Pump (Alternate)	1
F	715 FT-40	Parker Shut-Off Valve	1
G	4CCCT	Parker Elbow (Beneath Tank)	1
H	5116834	Tank	1
J	AF811CT453	Elbow (Tank Vent)	1
K	3115-1HT-4D	Parker Bulkhead Coupling	6
	11-1039-1-2D	Lock Nut	6
L	53612-F	Slinger Ring	2
M	52745	Bracket Assembly	6
N	AN844-4	Elbow (Between Slinger Ring and Hose)	2
O	AN884-4-12	Hose	10
P	3117-4T-4D	Parker Connecter	2
	11-1039-1-2D	Parker Lock Nut	2

(Banding—Red and White)

Item	*Part No.*	*No. Req*	*Size*	*Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
1	2116288-2 RH	1	1/4 OD x .035	52SO	38-1/4	AF811BT4D AF811T4CS	2 2	Pump to union (tunnel line) RH
	2116288-3 LH	1	1/4 OD x .035	52SO	38-1/4	AF811BT4D AF811T4CS	2 2	Pump to union (tunnel line) LH
2	5112325-10 LH	1	1/4 OD x .035	52SO	24-1/4			Hose to slinger ring LH nacelle
	5112325-9 RH	1	1/4 OD x .035	52SO	23			Hose to slinger ring RH nacelle
3	5112325-5 LH	1	1/4 OD x .035	52SO	20-1/2	AF811BT4-4D AF811T-4CS	1 1	Diaphragm to hose LH nacelle
	5112325-2 RH	1	1/4 OD x .035	52SO	24-1/2	AF811BT-4D AF811T-4CS	1 1	Diaphragm to hose RH nacelle
4	2116288-1	1	1/4 OD x .035	52SO	6-3/4	AF811BT4D AF811T4CS	2 2	Tank to pump
5	5112325-8 LH	1	1/4 OD x .035	52SO	6			Hose to diaphragm LH nacelle
	5112325-7 RH	1	1/4 OD x .035	52SO	15-1/2			Hose to diaphragm RH nacelle

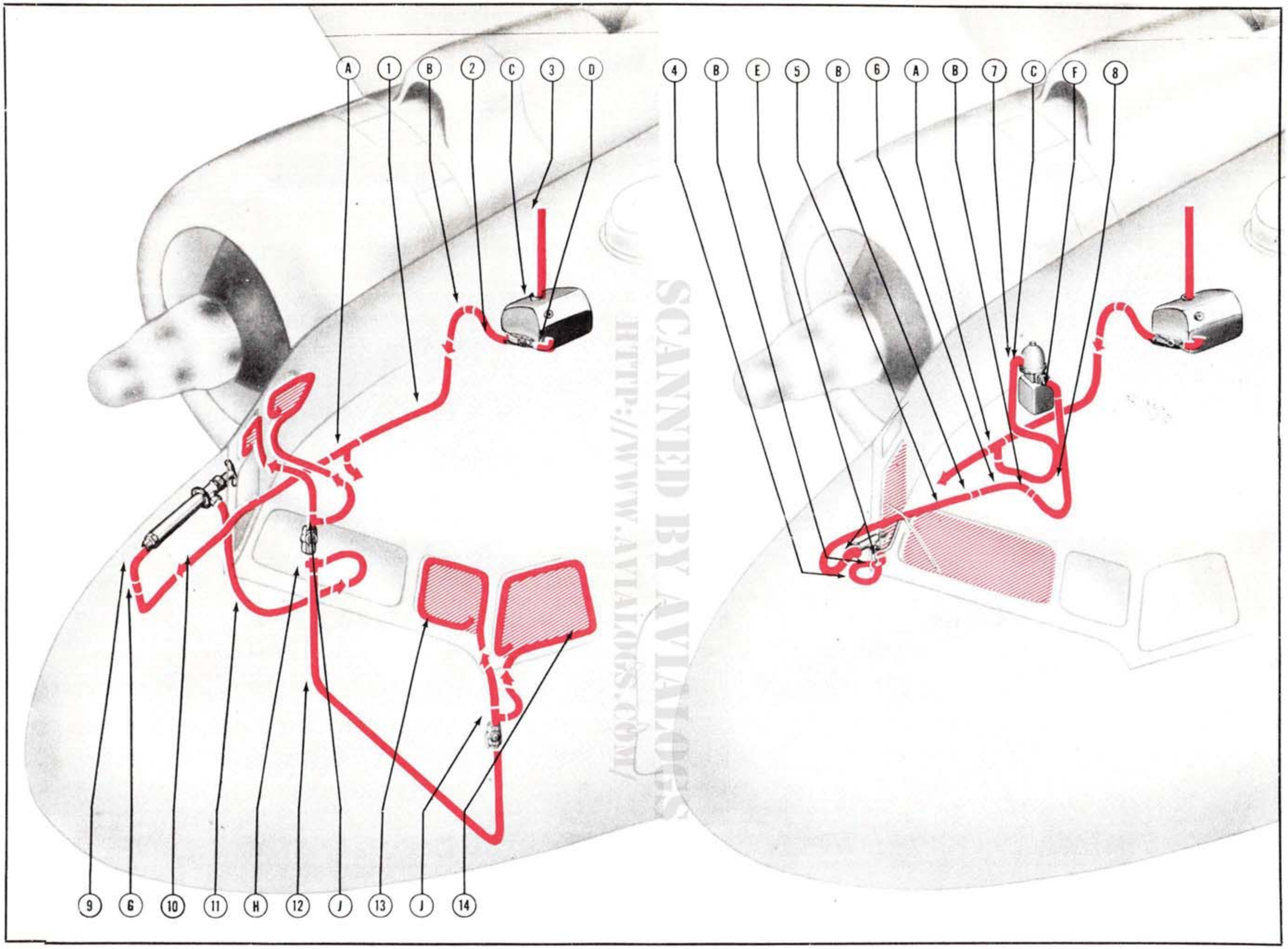

A
1
B
2
C
3
D
4
B
E
5
B
6
A
B
7
C
F
8
9
G
10
11
H
12
J
13
J
14

Figure 648—Windshield Anti-Icer System (Lines and Fittings)

KEY TO FIGURE 647—Continued

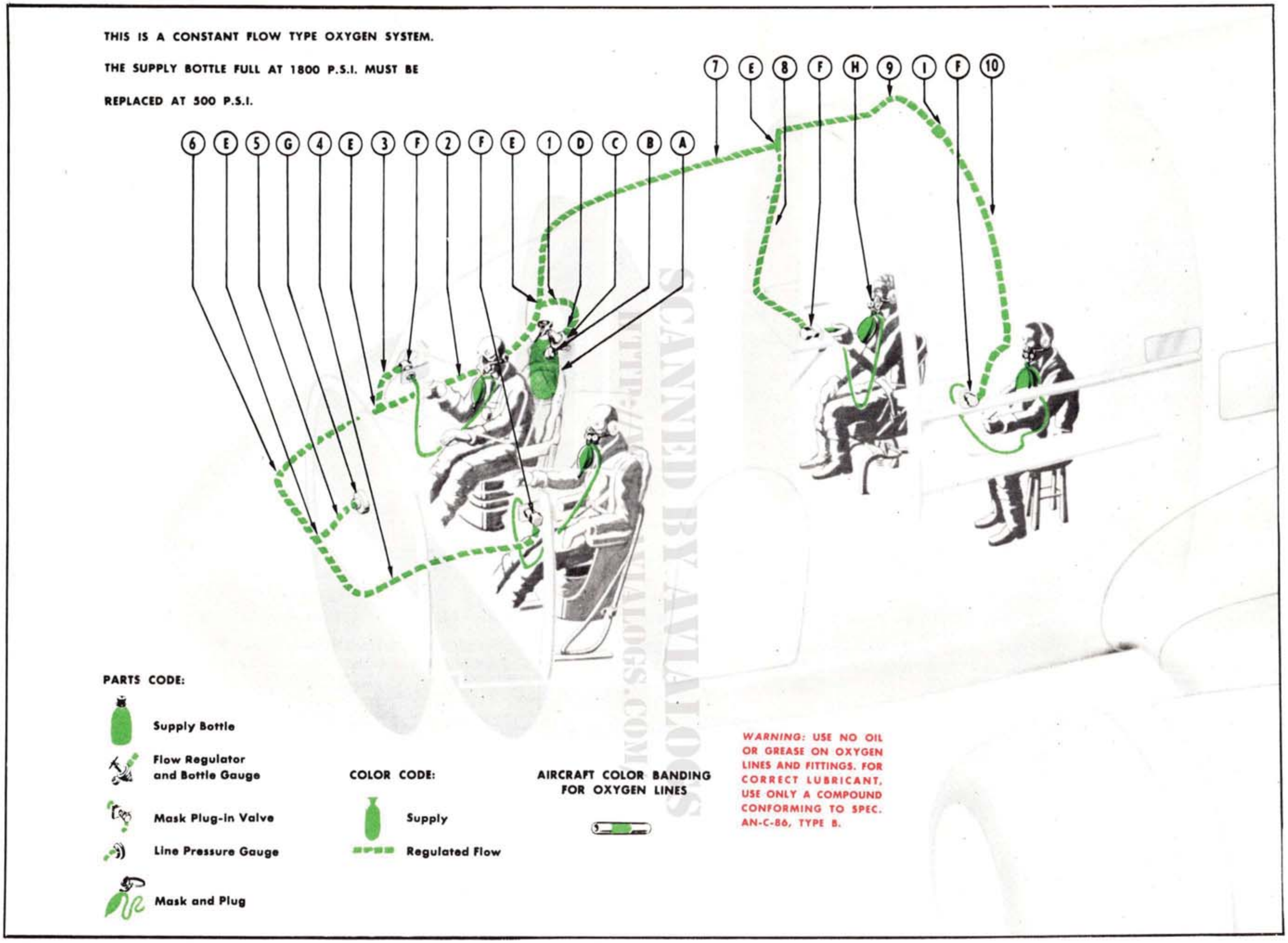
Item	*Part No.*	*No. Req*	*Size*	*Material*	*Lgth*	*Fittings*	*Ftgs Per Line*	*Description*
6	2116288-4	1	3/16 OD x .035	52SO	54-3/4	AF811BT3D	1	Tank to vent
						AF811T3CS	1	
7	5112325-3 LH	1	1/4 OD x .035	52SO	22			Fire wall to hose
								LH nacelle
	5112325-6 RH	1	1/4 OD x .035	52SO	21-1/2			Fire wall to hose
								RH nacelle
8	2118106-3 LH	1	1/4 OD x .035	52SO	34-3/4	AF811BT4D	2	Nacelle panel to
						AF811T4CS	2	fire wall LH
	2118106-4 RH	1	1/4 OD x .035	52SO	34-3/4	AF811BT4D	2	Nacelle panel to
						AF811T4CS	2	fire wall RH
9	2118106-1 RH	1	1/4 OD x .035	52SO	60-1/2	AF811BT4D	2	Wing panel to RH
						AF811T4CS	2	nacelle panel
	2118106-2 LH	1	1/4 OD x .035	52SO	113-1/2	AF811BT4D	2	Wing panel to LH
	(Was 2118106-3)					AF811T4CS	2	nacelle panel
10	2116288-5 LH	1	1/4 OD x .035	52SO	116-1/4	AF811BT4D	2	Union (tunnel line) to union (wing panel) LH
	2116288-6 RH	1	1/4 OD x .035	52SO	117-3/4	AF811BT4D	2	Union (tunnel line) to
						AF811T4CS	2	union (wing panel) RH

KEY TO FIGURE 648

Item	*Part No.*	*Part Name*	*No. Req Per Airplane*
A	AF811JT4D	Tee	1
B	AF811 HT4D	Union	4
C	AF811FT-4D	Nipple	2
D	1/8CD-D	Parker Elbow (Beneath Tank)	1
E	AN822-4D	Elbow (On Needle Valve)	2
F	8F811-CT-4D	Elbow (Pump Outlet)	1
G	6-4-HT-D	Parker Union	1
H	6-4-4-2KST	Parker Cross	1
	ENT-4D	Parker Cap	1
J	AF811RT3D	Tee	2

(Banding—Red and White)

Item	*Part No.*	*No. Req*	*Size*	*Material*	*Lgth*	*Fittings*	*Ftgs per Line*	*Description*
1	4116774-26	1	1/4 OD x .035	52SO	59-1/2	AF811BT4D	2	Union to tee
						AF811T4CS	2	
2	4116774-24	1	1/4 OD x .035	52SO	6	AF811BT4D	2	Tank to union
						AF811T4CS	2	
3	4116774-6	1	1/4 OD x .035	52SO	6	AF811BT4D	1	Tank vent
						AF811T4CS	1	
4	4116774-22	1	1/4 OD x .035	52SO	5-3/4 (Form) (Was 19-1/2)			Valve to union Station (38)
5	4116774-4	1	1/4 OD x .035	52SO	57 (Was 94 and 127)	AF811BT4D	2	Union (Station 63) to
						AF811T4CS	2	needle valve
6	4116774-16	1	1/4 OD x .035	52SO	18-3/4	AF811BT4D	2	Union to union (station
						AF811T4CS	2	83 to 63) was (station 86 to 63)
7	4116774-31	1	1/4 OD x .035	52SO	40			Tee to pump
8	4116774-32	1	1/4 OD x .035	52SO	31	AF811BT4D	2	Pump to union
						AF811T4CS	2	
9	4116774-1	1	3/8 OD x .035	52SO	5-3/8		2	Union to hand pump



THIS IS A CONSTANT FLOW TYPE OXYGEN SYSTEM.

THE SUPPLY BOTTLE FULL AT 1800 P.S.I. MUST BE REPLACED AT 500 P.S.I.

⑥
Ⓔ
⑤
Ⓖ
④
Ⓔ
③
Ⓕ
②
Ⓕ
Ⓔ
①
Ⓓ
Ⓒ
Ⓑ
Ⓐ
⑦
Ⓔ
⑧
Ⓕ
Ⓗ
⑨
Ⓘ
Ⓕ
⑩
PARTS CODE:
Supply Bottle
Flow Regulator and Bottle Gauge
Mask Plug-in Valve
Line Pressure Gauge
Mask and Plug
COLOR CODE:
Supply
Regulated Flow
AIRCRAFT COLOR BANDING FOR OXYGEN LINES

WARNING: USE NO OIL OR GREASE ON OXYGEN LINES AND FITTINGS. FOR CORRECT LUBRICANT, USE ONLY A COMPOUND CONFORMING TO SPEC. AN-C-86, TYPE B.

Figure 649—High-Pressure Oxygen System (Lines and Fittings)

KEY TO FIGURE 648—Continued

Item	Part No.	No. Req	Size	Material	Lgth	Fittings	Ftgs Per Line	Description
10	4116774-2	1	1/4 OD x .035	52SO	47		2	Tee to union
11	4116774-7	1	3/8 OD x .035	52SO	43		2	Hand pump to cross
12	4116774-3	1	1/4 OD x .028	52SO	109	1	1	Cross to LH windshield valve
13	2116039-LH 2116039-RH	2 2	3/16 OD x .035	52SO	59	AF811BT3D Nut AF811T3CS Sleeve	1	Tee to around front windshield
14	2116038 LH 2116038-1 RH	2 2	3/16 OD x .035	52SO (Was copper)	76 76	AF811BT3D Nut AF811T3CS Sleeve	1	Tee to around rear windshield

ADDITIONAL LINES ON SOME AIRPLANES (C-47) BEFORE ELECTRIC PUMP WAS ADDED

4116774-5
4116774-8
4116774-9
4116774-10
4116774-12
4116774-14

ADDITIONAL LINES ON SOME AIRPLANES (C-47)

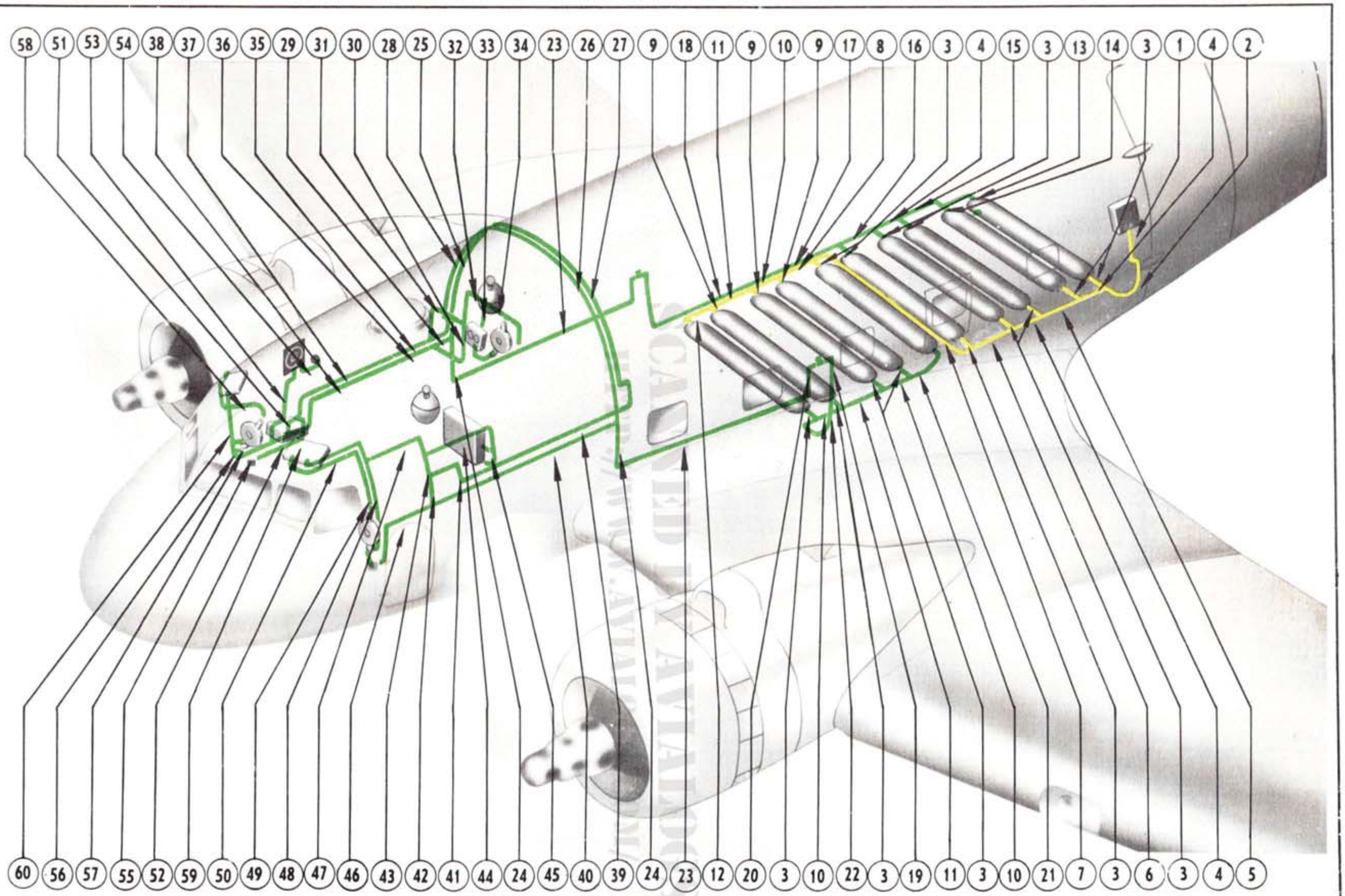
Part No.	Size	Material	Fittings	Description
4116774-18				
4116774-20				
4116774-28				
4116774-29	1/4 OD x .035	*Form	AF811BT3D Nut	Tee to pump
4116774-30	1/4 OD x .035	*Form	AF811T3CS Sleeve	Tee to pump
4141107-6				
4141107-4				
4141107-3				
4141107-2				

*Undetermined length

KEY TO FIGURE 649

Item	Part No.	No. Req Apl	Material	Length	Location	Fittings
1	4118266-1	1	52SO 1/4 x .035 OD	11-5/8	Regulator to tee	811BT4 811T4CS
2	4118266-4	1	52SO 1/4 x .035 OD	48	Tee to tee	811BT4 811T4CS
3	4118266-9	1	52SO 1/4 x 0.35 OD	10-1/4	Tee to disconnect valve	811BT4 811T4CS
4	4118266-8	1	52SO 1/4 x .035 OD	59-7/8	Tee to tee	811BT4 811T4CS
5	2118277-1	1	1/4 OD weatherhead flex. hose	9-1/2	Tee to pressure gage	014D 014D
6	4118266-6	1	52SO 1/4 x .035 OD	48-3/4	Tee to tee	811BT4 811T4CS
7	4118266-2	1	52SO 1/4 x .035 OD	60-5/8	Tee to tee	811BT4 811T4CS
8	4118266-3	1	52SO 1/4 x .035 OD	53-1/2	Tee to disconnect valve	811BT4 811T4CS
9	4118266-10	1	52SO 1/4 x .035 OD	35-1/2	Tee to union	811BT4 811T4CS
10	4118266-11	1	52SO 1/4 x .035 OD	90-1/2	Union to disconnect valve	811BT4 811T4CS

Item	Part No.	Part Name	Req
A	24042	Kidde Lightweight Cylinder	1
B	23140	Pressure Gage	1
C	92AC	Harris Modifier Regulator	1


58
51
53
54
38
37
36
35
29
31
30
28
25
32
33
34
23
26
27
9
18
11
9
10
9
17
8
16
3
4
15
3
13
14
3
1
4
2
60
56
57
55
52
59
50
49
48
47
46
43
42
41
44
24
45
40
39
24
23
12
20
3
10
22
3
19
11
3
10
21
7
3
6
3
4
5

COLOR CODE:

🟩 Distribution Lines

🟨 Filler Lines

AIRCRAFT COLOR BANDING FOR OXYGEN LINES

Distribution Lines

Filler Lines

THIS IS A DEMAND TYPE OXYGEN SYSTEM. SYSTEM PRESSURE MUST NOT EXCEED 450 P.S.I. WHEN FILLING AND MUST NOT FALL BELOW 50 P.S.I. BEFORE REFILLING.

WARNING: OXYGEN FITTINGS, INSTRUMENTS AND ALL GROUND EQUIPMENT MUST BE KEPT ABSOLUTELY FREE FROM OIL, GREASE AND DIRT.

Figure 650—Low-Pressure Oxygen System (Lines)

KEY TO FIGURE 649—Continued

Item	*Part No.*	*Part Name*	*Req*
D	AF811CT4D	Elbow	1
	AN895-80	Reducer Bushing	1
E	AF811JT4-D	Tee	4
F	S-1108339-A	Oxygen Disconnect Valve And Plug	4
G	AW-1-7/8-15-AV	16 U. S. Gage	1
H	A-8-B	Mask	4

KEY TO FIGURE 650

NOTE: Cylinders are numbered from aft end.

Item	*Part No.*	*No. Req Apl*	*Material*	*Lgth*	*Location*	*Fittings*
1	5143016-2	1	52SO 5/16 x .035 OD	15	Filler valve to union	AN818-5D AN819-5D
2	5143016-108	1	52SO 5/16 x .035 OD	24	Union to tee, cylinder No. 1	AN818-5D AN819-5D
3	5143016-16	13	52SO 5/16 x .035 OD	7	Check valve tee to cylinder	AN818-5D AN819-5D
4	5143016-10	3	52SO 5/16 x .035 OD	5-1/2	Cylinder No. 3 to cylinder No. 4	AN818-5D AN819-5D
5	5143016-30	1	52SO 5/16 x .035 OD	14	Cylinder No. 2 to cylinder No. 3	AN818-5D AN819-5D
6	5143016-12	1	52SO 5/16 x .035 OD	12	Cylinder No. 4 to cylinder No. 5	AN818-5D AN819-5D
7	5143016-18	1	52SO 5/16 x .035 OD	75	Cylinder No. 5 to cylinder No. 6	AN818-5D AN819-5D
8	5143016-22	1	52SO 5/16 x .035 OD	10	Cylinder No. 6 to cylinder No. 7	AN818-5D AN819-5D
9	5143016-112	3	52SO 5/16 x .035 OD	5	Check valve tee to cylinders Nos. 9 and 10	AN818-5D AN819-5D
10	5143016-24	3	52SO 5/16 x .035 OD	5-1/2	Check valve to check valve	AN818-5D AN819-5D
11	5143016-26	2	52SO 5/16 x .035 OD	29-1/2	Cylinder No. 8 to cylinder No. 9	AN818-5D AN819-5D
12	5143016-4	1	52SO 5/16 x .035 OD	12	Cylinder No. 10 to tee	AN818-5D AN819-5D
13	5143016-8	1	52SO 5/16 x .035 OD	11	Cylinder No. 1 to cylinder No. 2	AN818-5D AN819-5D
14	5143016-32	1	52SO 5/16 x .035 OD	8	Cylinder No. 2 to check valve	AN818-5D AN819-5D
15	5143016-6	1	52SO 5/16 x .035 OD	36	Cylinder No. 2 to cylinder No. 3	AN818-5D AN819-5D
16	5143016-36	1	52SO 5/16 x .035 OD	15-1/2	Cylinder No. 4 to cylinder No. 5	AN818-5D AN819-5D
17	5143016-110	1	52SO 5/16 x .035 OD	50	Check valve No. 5 to union	AN818-5D AN819-5D
18	5143016-38	1	52SO 5/16 x .035 OD	34	Check valve, cylinder No. 10 to union LH	AN818-5D AN819-5D
19	5143016-42	2	52SO 5/16 x .035 OD	40	Union to pipe valve	AN818-5D AN819-5D
20	5143016-44	2	52SO 5/16 x .035 OD	35	Pipe valve to elbow	AN818-5D AN819-5D
21	5143016-20	1	52SO 5/16 x .035 OD	5-1/2	Cylinder No. 6 to check valve at No. 7	AN818-5D AN819-5D
22	5143016-40	1	52SO 5/16 x .035 OD	50	Union to union	AN818-5D AN819-5D
23	5143016-46	2	52SO 5/16 x .035 OD	110	Elbow to elbow	AN818-5D AN819-5D

KEY TO FIGURE 650—Continued

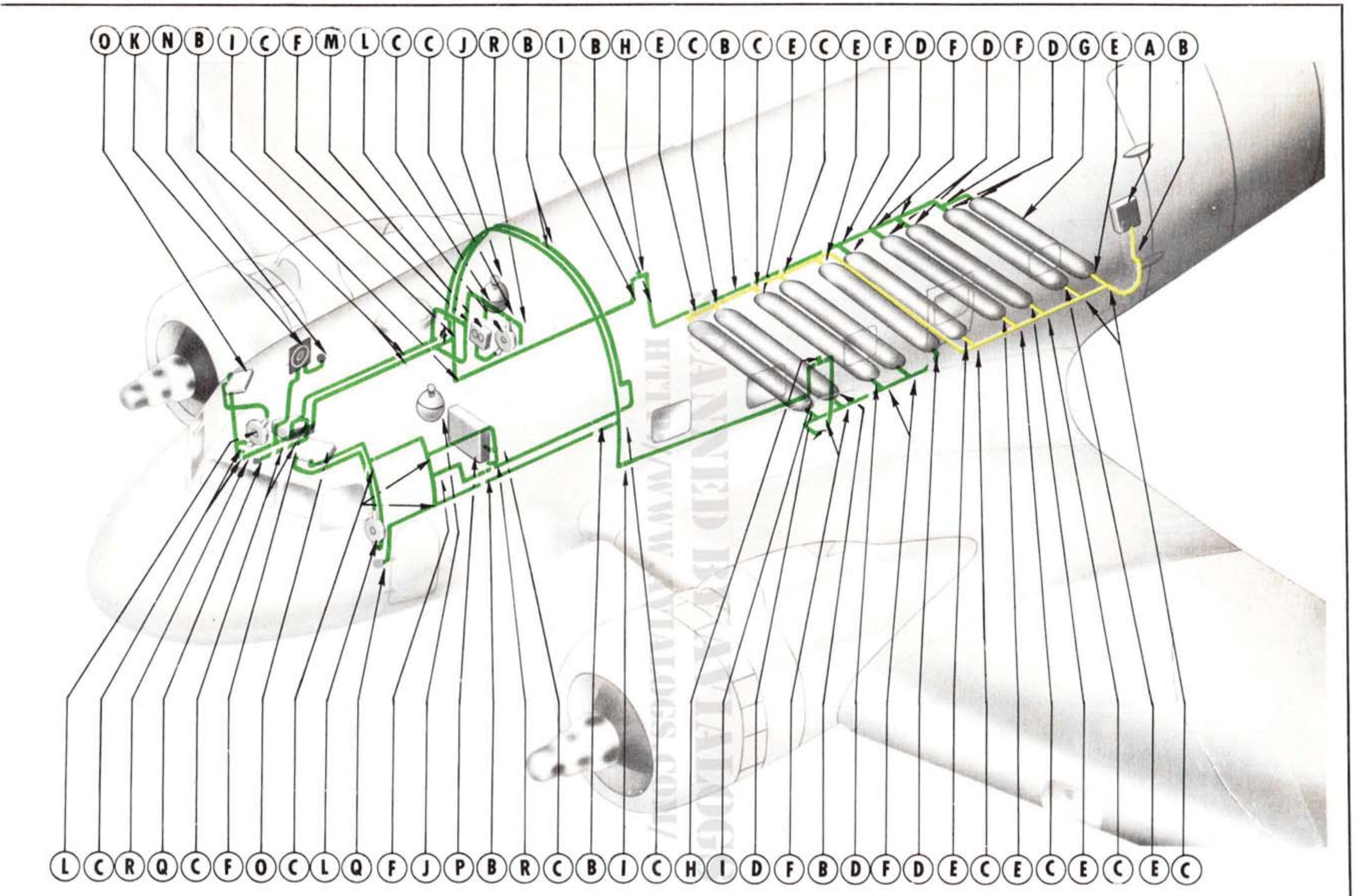
Item	*Part No.*	*No. Req Apl*	*Material*	*Lgth*	*Location*	*Fittings*
24	5143016-48	2	52SO 5/16 x .035 OD	38	Elbow to tee	AN818-5D AN819-5D
25	5143016-50	1	52SO 5/16 x .035 OD	50	Tee RH to union	AN818-5D AN819-5D
26	5143016-52	1	52SO 5/16 x .035 OD	55	Tee LH to union	AN818-5D AN819-5D
27	5143016-114	1	52SO 5/16 x .035 OD	14	Union to union LH	AN818-5D AN819-5D
28	5143016-96	1	52SO 5/16 x .035 OD	7	Tee to union RH	AN818-5D AN819-5D
29	5143016-54	1	52SO 5/16 x .035 OD	5	Tee to tee RH	AN818-5D AN819-5D
30	5143016-88	1	52SO 5/16 x .035 OD	18	Tee to check valve	AN818-5D AN819-5D
31	5143016-90	1	52SO 5/16 x .035 OD	18	Tee to check valve	AN818-5D AN819-5D
32	5143016-92	1	52SO 5/16 x .035 OD	15	Check valve to tee	AN818-5D AN819-5D
33	5143016-98	1	52SO 5/16 x .035 OD	11	Tee to pressure gage	AN818-5D AN819-5D
34	5143016-94	1	52SO 5/16 x .035 OD	17	Tee to tee	AN818-5D AN819-5D
35	5143016-56	1	52SO 5/16 x .035 OD	36	Tee to union RH	AN818-5D AN819-5D
36	5143016-58	1	52SO 5/16 x .035 OD	36	Tee to union RH	AN818-5D AN819-5D
37	5143016-116	1	52SO 5/16 x .035 OD	48	Union to tee	AN818-5D AN819-5D
38	5143016-122	1	52SO 5/16 x .035 OD	68-3/4	Union to check valve RH	AN818-5D AN819-5D
39	5143016-62	1	52SO 5/16 x .035 OD	45	Union to union LH	AN818-5D AN819-5D
40	5143016-66	1	52SO 5/16 x .035 OD	82	Union to union LH	AN818-5D AN819-5D
41	5143016-64	1	52SO 5/16 x .035 OD	42	Union to check valve LH	AN818-5D AN819-5D
42	5143016-60	1	52SO 5/16 x .035 OD	5	Tee to check valve LH	AN818-5D AN819-5D
43	5143016-14	1	52SO 5/16 x .035 OD	6	Check valve to tee LH	AN818-5D AN819-5D
44	5143016-102	1	52SO 5/16 x .035 OD	56	Tee to tee (Nav Compt)	AN818-5D AN819-5D
45	5143016-34	1	52SO 5/16 x .035 OD	15	Tee to tee (Nav Compt)	AN818-5D AN819-5D
46	5143016-68	1	52SO 5/16 x .035 OD	18	Tee to signal assembly LH	AN818-5D AN819-5D
47	5143016-72	1	52SO 5/16 x .035 OD	16	Tee to tee LH	AN818-5D AN819-5D
48	5143016-28	1	52SO 5/16 x .035 OD	6	Regulator to tee	AN818-5D AN819-5D
49	5143016-78	1	52SO 5/16 x .035 OD	44	Regulator to flow indicator	AN818-5D AN819-5D
50	5143016-76	1	52SO 5/16 x .035 OD	50	Tee to pressure gage	AN818-5D AN819-5D
51	5143016-120	1	52SO 5/16 x .035 OD	9	Tee to check valve	AN818-5D AN819-5D

KEY TO FIGURE 650—Continued

Item	Part No.	No. Req Apl	Material	Lgth	Location	Fittings
52	5143016-128	1	52SO 5/16 x .035 OD	41-1/2	Check valve to tee	AN818-5D AN819-5D
53	5143016-124	1	52SO 5/16 x .035 OD	67-1/2	Tee to regulator	AN818-5D AN819-5D
54	5143016-126	1	52SO 5/16 x .035 OD	11	Regulator to flow indicator	AN818-5D AN819-5D
55	5143016-130	1	52SO 5/16 x .035 OD	44-1/2	Tee to bulkhead	AN818-5D AN819-5D
56	5143016-118	1	52SO 5/16 x .035 OD	48	Tee to tee	AN818-5D AN819-5D
57	5143016-80	1	52SO 5/16 x .035 OD	6	Tee to regulator	AN818-5D AN819-5D
58	5143016-84	1	52SO 5/16 x .035 OD	50	Tee to pressure gage	AN818-5D AN819-5D
59	5143016-70	1	52SO 5/16 x .035 OD	28	Tee to signal assembly RH	AN818-5D AN819-5D
60	5143016-82	1	52SO 5/16 x .035 OD	44	Regulator to flow indicator	AN818-5D AN819-5D

KEY TO FIGURE 651

Item	Part No.	Name	No. Req Per Airplane
A	4202415	Box Assembly	1
		Consists of:	
	2143004	Bag Assembly	1
	42A6950	British Adapter	1
	40326	Type 1—Filler Valve	1
	1143073	Chain Assembly	1
B	AN815-5D	Union	10
C	AN824-5D	Tee	23
D	AN816-5D	Nipple	10
E	43A9036	Style "A" Check Valve	10
F	43A9030	Style "D" Check Valve	11
G	5143344	Cylinder F-2	10
H	40386	Type 1-Line Valve	2
I	AN833-5D	Elbow	4
J	42D5357	Portable Cylinders	4
		Contained in:	
	5142793	Box Assembly—Navigator's	1
	4142789	Box Assembly—Radio Operator's	1
	4142792	Box Assembly—Pilot's and Copilot's	1
K	2204243	Panel	1
		Contains:	
		A-12 Regulator	Ref L
L	40370	Type A-12 Regulator	5
		Connected by:	
	AN822-5D	Elbow—Radio Operator's	1
	AN825-5D	Tee—Radio Operator's	1
	AN822-5D	Elbows—Navigator's and Copilot's	4
	AN822-5D	Elbow—Pilot's and Flight Mechanic's	2
	AN816-5D	Nipple—Pilot's and Flight Mechanic's	2
		Includes:	
	AN6003-1	Tube Assembly	5


O K N B I C F M L C C J R B I B H E C B C E C E F D F D F D G E A B
L C R Q C F O C L Q F J P B R C B I C H I D F B D F D E C E C E C E C

COLOR CODE:

🟩 **Distribution Lines**

🟨 **Filler Lines**

AIRCRAFT COLOR BANDING FOR OXYGEN LINES

🟩 **Distribution Lines**

🟩🟨🟩 **Filler Lines**

THIS IS A DEMAND TYPE OXYGEN SYSTEM. SYSTEM PRESSURE MUST NOT EXCEED 450 P.S.I. WHEN FILLING AND MUST NOT FALL BELOW 50 P.S.I. BEFORE REFILLING.

***WARNING:* OXYGEN FITTINGS, INSTRUMENTS AND ALL GROUND EQUIPMENT MUST BE KEPT ABSOLUTELY FREE FROM OIL, GREASE AND DIRT.**

Figure 651—Low-Pressure Oxygen System (Fittings)

KEY TO FIGURE 651

Item	*Part No.*	*Name*	*No. Req per Airplane*
M	4143143	Box Assembly (Radio Operator)	1
		Contains:	
	40427	Type A-3 Flow Indicator	1
	AN822-5D	Elbow	1
	5143016-100	Pipe	1
	94-27368	Type K-1 Pressure Gage	1
	AN822-5D	Elbow	1
	42B3593	Indicator Lamp Assembly	1
N	2203109	Indicator Assembly (Flight Mech)	1
O	5143349	Overhead Panel (Pilot's and Copilot's)	2
		Consists of:	
	40427	Type A-3 Flowmeter	2
	AN822-5D	Elbow	1
	94-27368	Type K-1 Pressure Gage	2
	AN823-5D	Elbow	1
	42B3593	Indicator Lamp Assembly	2
P	5143346	Navigator's Equipment	1
		Consists of:	
	40427	Type A-3 Flow Indicator	1
	94-27368	Type K-1 Pressure Gage	1
	42B3593	Indicator Lamp Assembly	1
	AN824-5D	Tee	1
	AN6004-1	Regulator	Ref L
Q	94-32376	Type G-1 Pressure Signal	2
	AN822-5D	Elbow	2
R	42D7261	Portable Oxygen Recharger	3

KEY TO FIGURES 651A, 651B

LINES

NOTE: Cylinders are numbered from forward end.

Item	*Part No.*	*No. Req Apl*	*Material*	*Lgth*	*Location*	****Fittings (2 each per line)*
1	5202132-2	1	5/16 OD x .035 52SO	40-1/2	Regulator to blinker (Pilot)	AN818-5D AN819-5D
2	5202132-4	1	5/16 OD x .035 52SO	41-1/4	Tee to pressure gage (Pilot)	AN818-5D AN819-5D
3	5202132-10	1	5/16 OD x .035 52SO	3-1/2	Tee to regulator (Pilot)	AN818-5D AN819-5D
4	5202132-12	1	5/16 OD x .035 52SO	12-3/8	*Tee to tee **Tee to union	AN818-5D AN819-5D
	††5202132-12	1	5/16 OD x .035 52SO	9-7/8	Tee to union	AN818-5D 44A25450
5	*5202132-14	1	5/16 OD x .035 52SO	13-5/8	Tee to pressure signal (Pilot)	AN818-5D AN819-5D

*On early C-47B airplanes. **On late C-47B airplanes. ***On very late C-47B airplanes the AN819-5D fitting is replaced with 44A25450 sleeve. †Deleted on very late C-47B airplanes. ††On very late C-47B airplanes.

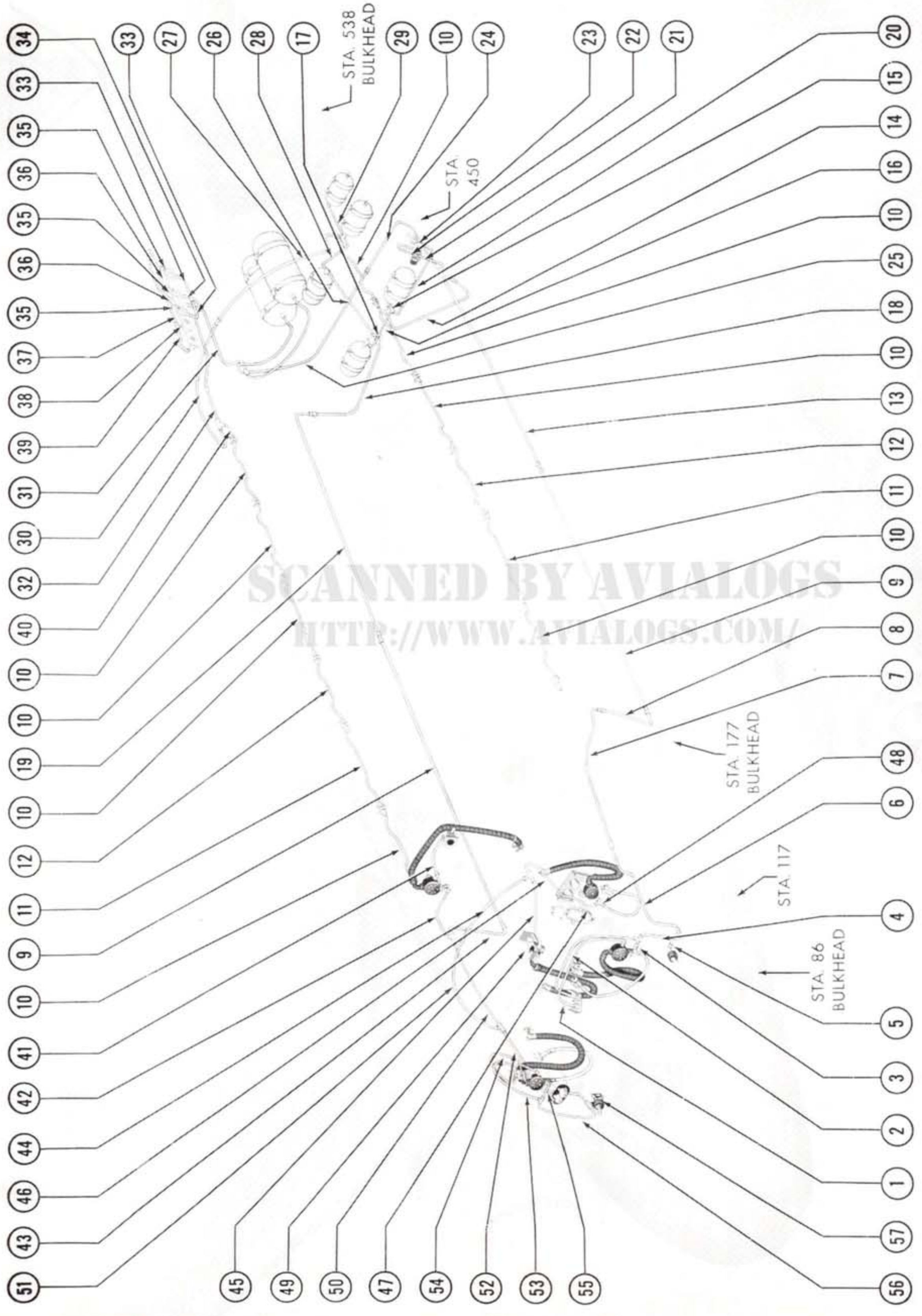

STA. 538 BULKHEAD
STA. 450
STA. 177 BULKHEAD
STA. 117
STA. 86 BULKHEAD
34
33
35
36
35
36
35
37
38
39
31
30
32
40
10
10
19
10
12
11
9
10
41
42
44
46
43
51
33
27
26
28
17
29
10
24
23
22
21
20
15
14
16
10
25
18
10
13
12
11
10
9
8
7
48
6
4
5
3
2
1
57
56
45
49
50
47
54
52
53
55

Figure 651 A—Low Pressure Demand and Constant Flow Oxygen Systems (Lines and Fittings)

KEY TO FIGURES 651A, 651B-LINES—Continued

Item	*Part No.*	*No. Req Apl*	*Material*	*Lgth*	*Location*	****Fittings (2 each per line)*
6	5202132-16	1	5/16 OD x .035 52SO	25-3/8	Tee to union (Pilot)	AN818-5D AN819-5D
	††5202132-16	1	5/16 OD x .035 52SO	24-3/4	Union to union	AN818-5D 44A25450
7	5202132-46	1	5/16 OD x .035 52SO	65-3/4	Union to union (Pilot)	AN818-5D AN819-5D
	††5202132-46	1	5/16 OD x .035	63-3/4	Union to union	AN818-5D 44A25450
8	5202132-48	1	5/16 OD x .035 52SO	33	Union to union (Pilot)	AN818-5D AN819-5D
	††5202132-48	1	5/16 OD x .035 52SO	37	Union to union	AN818-5D 44A25450
9	5202132-52	2	5/16 OD x .035 52SO	144	Union to union (Pilot & Copilot)	AN818-5D AN819-5D
10	5204979-28	8	5/16 OD x .035 52SO	36	Manifold to manifold	AN818-5D AN819-5D
11	5204979-32	2	5/16 OD x .035 52SO	35-5/16	Between manifold No. 5—No. 6	AN818-5D AN819-5D
12	5204979-52	2	5/16 OD x .035 52SO	33-3/4	Between manifold No. 4—No. 5	AN818-5D AN819-5D
13	5202132-54	1	5/16 OD x .035 52SO	88-3/4	Union to union	AN818-5D AN819-5D
14	5202132-60	1	5/16 OD x .035 52SO	85-1/2	Union to cylinder No. 1	AN818-5D AN819-5D
15	**5202132-76	1	5/16 OD x .035 52SO	4-1/8	Tee to cylinder No. 1	AN818-5D AN819-5D
16	**5202132-74	1	5/16 OD x .035 52SO	21-1/8	Tee to cylinder No. 2	AN818-5D AN819-5D
17	**5202132-62	1	5/16 OD x .035 52SO	12-3/4	Tee to cylinder No. 2	AN818-5D AN819-5D
18	5202132-58	1	5/16 OD x .035 52SO	59	*Union to tee **Elbow to tee	AN818-5D AN819-5D
19	5202132-56	1	5/16 OD x .035 52SO	111	*Union to union **Elbow to tee	AN818-5D AN819-5D
20	**5202132-72	1	5/16 OD x .035 52SO	51	Tee to tee	AN818-5D AN819-5D
21	**5204979-40	1	5/16 OD x .035 52SO	44-1/2	Line valve to union	AN818-5D AN819-5D
22	*5204979-38	1	5/16 OD x .035 52SO	17-1/2	Tee to line valve	AN818-5D AN819-5D
23	*5204979-50	1	5/16 OD x .035 52SO	5-3/4	Filler valve to tee	AN818-5D AN819-5D
24	*5204979-42	1	5/16 OD x .035 52SO	41	Union to union	AN818-5D AN819-5D
25	*5204979-44	1	5/16 OD x .035 52SO	82	Union to cross	AN818-5D AN819-5D

*On early C-47B airplanes. **On late C-47B airplanes. ***On very late C-47B airplanes the AN819-5D fitting is replaced with 44A25450 sleeve. †Deleted on very late C-47B airplanes. ††On very late C-47B airplanes.

KEY TO FIGURES 651A, 651B-LINES—Continued

Item	*Part No.*	*No. Req Apl*	*Material*	*Lgth*	*Location*	****Fittings (2 each per line)*
26	**5202132-64	1	5/16 OD x .035 52SO	52	Tee to cylinder No. 3	AN818-5D AN819-5D
27	5204979-36	1	5/16 OD x .035 52SO	62-1/2	Union to manifold No. 1	AN818-5D AN819-5D
28	5202132-66	1	5/16 OD x .035 52SO	20-1/2	Cylinder No. 3 to cylinder No. 4	AN818-5D AN819-5D
29	5202132-68	1	5/16 OD x .035 52SO	33	Cylinder No. 4 to cylinder No. 5	AN818-5D AN819-5D
30	5204979-34	1	5/16 OD x .035 52SO	80	Tee to union	AN818-5D AN819-5D
31	5204979-18	1	5/16 OD x .035 52SO	58-1/2	Tee to cross	AN818-5D AN819-5D
32	5204979-24	1	5/16 OD x .035 52SO	52-5/8	Cross to tee	AN818-5D AN819-5D
33	5204979-20	2	5/16 OD x .035 52SO	12-1/2	Regulator to cross	AN818-5D AN819-5D
34	*5204979-46	1	5/16 OD x .035 52SO	5-1/4	Regulator to cross	AN818-5D AN819-5D
35	5204979-10	6	5/16 OD x .035 52SO	9-3/8	Tee to regulator, 3. Tee to tee, 2. Regulator to cross, 1.	AN818-5D AN819-5D
36	*5204979-14	2	5/16 OD x .035 52SO	5-1/4	Tee to tee	AN818-5D AN819-5D
37	*5204979-22	1	5/16 OD x .035 52SO	3-7/8	Tee to tee	AN818-5D AN819-5D
38	*5204979-12	1	5/16 OD x .035 52SO	10-5/8	Pressure switch to tee	AN818-5D AN819-5D
39	5204979-58	1	5/16 OD x .035 52SO	17	Cross to filler valve	AN818-5D AN819-5D
40	5204979-26	1	5/16 OD x .035 52SO	7-3/8	Tee to manifold	AN818-5D AN819-5D
41	5202132-44	1	5/16 OD x .035 52SO	19-1/4	Regulator to blinker (Radio Oper.)	AN818-5D AN819-5D
	††5202132-44	1	5/16 OD x .035 52SO	16-1/4	Regulator to blinker (Radio Oper.)	AN818-5D 44A52450
42	5202132-42	1	5/16 OD x .035 52SO	23-1/4	Tee to regulator (Radio Oper.)	AN818-5D AN819-5D
	††5202132-42	1	5/16 OD x .035 52SO	22-3/16	Tee to regulator (Radio Oper.)	AN818-5D 44A25450
43	5202132-50	1	5/16 OD x .035 52SO	32	Tee to union	AN818-5D AN819-5D
	††5202132-50		5/16 OD x .035 52SO	36	Tee to union	AN818-5D 44A52450
44	5202132-28	1	5/16 OD x .035 52SO	31-1/2	Union to tee	AN818-5D AN819-5D
	††5202132-28	1	5/16 OD x .035 52SO	30-1/2	Union to tee	AN818-5D 44A25450

*On early C-47B airplanes. **On late C-47B airplanes. ***On very late C-47B airplanes the AN819-5D fitting is replaced with 44A25450 sleeve. †Deleted on very late C-47B airplanes. ††On very late C-47B airplanes.

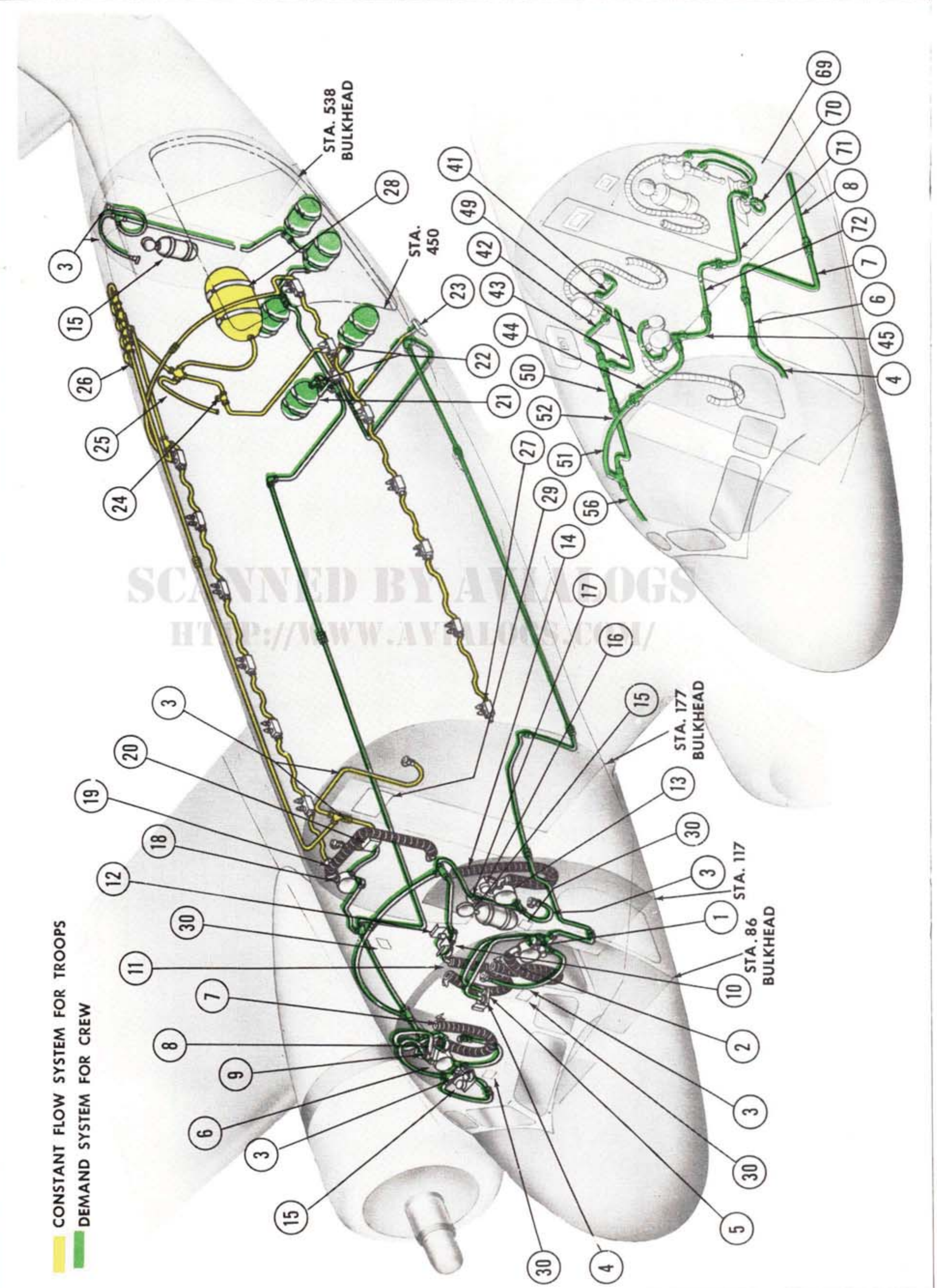

🟨 CONSTANT FLOW SYSTEM FOR TROOPS
🟩 DEMAND SYSTEM FOR CREW
STA. 538 BULKHEAD
STA. 450
STA. 177 BULKHEAD
STA. 117
STA. 86 BULKHEAD
69
70
71
8
72
7
6
45
4
41
49
42
43
44
50
52
51
56
28
23
22
21
27
29
14
17
16
15
13
30
3
1
10
2
3
30
5
4
30
15
3
6
9
8
7
11
30
12
18
19
20
3
24
25
26
15
3

Figure 651B—Low Pressure Demand and Constant Flow Oxygen Systems (Lines and Fittings) Late C-47B airplanes

KEY TO FIGURES 651A, 651B-LINES—Continued

Item	*Part No.*	*No. Req Apl*	*Material*	*Lgth*	*Location*	****Fittings (2 each per line)*
45	5202132-30	1	5/16 OD x .035 52SO	28-1/4	Tee to regulator (Flight Mech.)	AN818-5D AN819-5D
	††5202132-30	1	5/16 OD x .035 52SO	26	Union to regulator (Flight Mech.)	AN818-5D 44A25450
46	5202132-34	1	5/16 OD x .035 52SO	13-3/4	Tee to tee	AN818-5D AN819-5D
47	5202132-36	1	5/16 OD x .035 52SO	12-1/2	Regulator (Navigator to press. gage)	AN818-5D AN819-5D
48	5202132-38	1	5/16 OD x .035 52SO	10-1/8	Regulator (Nav.) to blinker (Flight Mech.)	AN818-5D AN819-5D
49	5202132-32	1	5/16 OD x .035 52SO	15-1/4	Regulator to blinker (Flight Mechanic)	AN818-5D AN819-5D
	††5202132-32	1	5/16 OD x .035 52SO	11-1/2	Regulator to blinker (Flight Mechanic)	AN818-5D 44A25450
50	5202132-40	1	5/16 OD x .035 52SO	54-3/4	Tee to tee	AN818-5D AN819-5D
	††5202132-40	1	5/16 OD x .035 52SO	54-3/4	Tee to union	AN818-5D 44A25450
51	5202132-26	1	5/16 OD x .035 52SO	56	Tee to union	AN818-5D AN819-5D
	††5202132-26	1	5/16 OD x .035 52SO	55	Tee to union	AN818-5D 44A25450
52	5202132-24	1	5/16 OD x .035 52SO	37-1/2	*Tee to tee **Tee to union	AN818-5D AN819-5D
	††5202132-24	1	5/16 OD x .035	36-1/2	Tee to union	AN818-5D 44A25450
53	5202132-8	1	5/16 OD x .035 52SO	40-1/2	Tee to pressure gage (Co-pilot)	AN818-5D AN819-5D
54	5202132-6	1	5/16 OD x .035 52SO	46-3/4	Regulator to blinker (Co-pilot)	AN818-5D AN819-5D
55	5202132-18	1	5/16 OD x .035 52SO	3-1/4	Tee to regulator (Co-pilot)	AN818-5D AN819-5D
56	5202132-20	1	5/16 OD x .035 52SO	31-1/2	Tee to tee (Co-pilot)	AN818-5D AN819-5D
	††5202132-20	1	5/16 OD x .035 52SO	25-1/8	Tee to tee	AN818-5D 44A25450
57	*5203132-22	1	5/16 OD x .035 52SO	13-3/4	Tee to pressure gage (Co-pilot)	AN818-5D AN819-5D
	*5204979-54	1	5/16 OD x .035 52SO	96-1/4	Line valve to union (Replaces 5204979-40 and 5204979-42)	AN818-5D AN819-5D
58	**5202132-82	1	5/16 OD x .035 52SO	18	Cylinder No. 2 to tee	AN818-5D AN819-5D
59	**5202132-84	1	5/16 OD x .035 52SO	60	Cylinder No. 3 to tee	AN818-5D AN819-5D
60	**5202132-80	2	5/16 OD x .035 52SO	13-5/8	Cylinder No. 1 to cross and Cylinder No. 2 to cross	AN818-5D AN819-5D

*On early C-47B airplanes. **On late C-47B airplanes. ***On very late C-47B airplanes the AN819-5D fitting is replaced with 44A25450 sleeve. †Deleted on very late C-47B airplanes. ††On very late C-47B Airplanes.

KEY TO FIGURES 651A, 651B-LINES—Continued

Item	*Part No.*	*No. Req Apl*	*Material*	*Lgth*	*Location*	****Fittings (2 each per line)*
61	**5204979-56	1	5/16 OD x .035 52SO	76	Line valve to cross	AN818-5D AN819-5D
62	**5204979-66	1	5/16 OD x .035 52SO	4-11/16	Tee to tee	AN818-5D AN819-5D
63	**5204979-68	1	5/16 OD x .035 52SO	6-9/16	Tee to pressure gage	AN818-5D AN819-5D
64	**5204979-62	1	5/16 OD x .035 52SO	144	Union to tee	AN818-5D AN819-5D
65	**5204979-60	1	5/16 OD x .035 52SO	141	Union to tee	AN818-5D AN819-5D
66	**5204979-64	1	5/16 OD x .035 52SO	23-1/4	Tee to recharger	AN818-5D AN819-5D
67	**5202132-78	1	5/16 OD x .035 52SO	59	Cross to filler valve	AN818-5D AN819-5D
68	**5202132-86	1	5/16 OD x .035 52SO	88	Cylinder No. 5 to recharger	AN818-5D AN819-5D
69	††5202132-88	1	5/16 OD x .035 52SO	42	Regulator to flow indicator	AN818-5D 44A25450
70	††5202132-90	1	5/16 OD x .035 52SO	53	Regulator to pressure gage	AN818-5D 44A25450
71	††5202132-92		5/16 OD x .035 52SO	52-1/2	Pressure gage to union	AN818-5D 44A25450
72	††5202132-94		5/16 OD x .035 52SO		Union to union	AN818-5D 44A25450

*On early C-47B airplanes. **On late C-47B airplanes. ***On very late C-47B airplanes the AN819-5D fitting is replaced with 44A25450 sleeve. †Deleted on very late C-47B airplanes. ††On very late C-47B airplanes.

KEY TO FIGURES 651A and 651B

FITTINGS

Item	*Part No.*	*Part Name*	*Remarks*	*No. Req*
1	AN822-5D	Elbow	On each end of line	2
2	AN822-5D	Elbow	On pressure gage	1
	AN824-5D	Tee	On aft end of line	1
3	AN825-5D	Tee	On regulator	1
4	*AN824-5D	Tee	On fwd end of line	1
	AN815-5D	Union	Replaces tee	1
5	*AN822-5D	Elbow	On pressure signal	1
6	AN815-5D	Union	On aft end of line	1
7	AN815-5D	Union	On aft end of line	1
8	AN815-5D	Union	On aft end of line	1
9	AN815-5D	Union	On aft end of line	2
10	AN913-1D	Plug	In manifold at fwd end of troop lines	2
13	*AN815-5D	Union	On aft end of line	1
	**AN821-5D	Elbow	On aft end of line	1
15	*AN824-5D	Tee	On fwd end of line	1

*On early C-47B airplanes only. **On late C-47B airplanes only. ††On very late C-47B airplanes.

KEY TO FIGURES 651A, and 651B-FITTINGS—Continued

Item	*Part No.*	*Part Name*	*Remarks*	*No. Req*
18	AN824-5D	Tee	On aft end of line	1
19	*AN815-5D	Union	On aft end of line	1
	**AN821-5D	Elbow	On aft end of line	1
20	*AN824-5D	Tee	On line in filler panel	1
21	*AN815-5D	Union	On aft end of line	1
24	*AN815-5D	Union	On RH end of line	1
25	*AN827-5D	Cross	On RH end of line	1
26	*AN825-5D	Tee	On aft end of line	1
	*AN912-1D	Reducer	On tee at oxygen cylinder	1
27	AN822-5D	Elbow	At manifold	1
28	AN825-5D	Tee	On line at LH oxygen cylinder	1
	AN912-1D	Reducer	On tee at oxygen cylinder	1
29	*AN822-5D	Elbow	On aft end of line	1
	**AN825-5D	Tee	On aft end of line	1
	AN912-1D	Reducer	At aft oxygen cylinder	1
30	AN815-5D	Union	On LH end of line	1
31	AN824-5D	Tee	On line at panel	1
32	AN824-5D	Tee	On fwd end of line	1
33	AN827-5D	Cross	On lines below panel	1
35	AN824-5D	Tee	On lines at panel	3
36	*AN824-5D	Tee	On fwd end of lines	2
37	*AN824-5D	Tee	On fwd end of line	1
	AN815-5D	Union	Replaces tee	1
38	*AN822-5D	Union	On pressure signal	1
39	*AN822-5D	Elbow	On pressure gage	1
	**AN827-5D	Cross	On upper end of line	1
41	AN822-5D	Elbow	On pressure gage	1
	AN823-5D	Elbow	On regulator	1
42	AN822-5D	Elbow	On regulator	1
	AN824-5D	Tee	On fwd end of line	1
43	AN815-5D	Union	On aft end of line	1
44	AN824-5D	Tee	On LH end of line	1
45	AN822-5D	Elbow	On regulator	1
46	AN825-5D	Tee	On pressure gage	1
47	AN826-5D	Tee	On regulator	1
48	AN822-5D	Elbow	On each end of line	2
49	AN822-5D	Elbow	On each end of line	2
50	AN824-5D	Tee	On fwd end of line	1
51	AN815-5D	Union	On LH end of line	1
52	**AN824-5D	Tee	On fwd end of line	1
	AN815-5D	Union	Replaces tee	1
53	AN822-5D	Elbow	On pressure gage	1
54	AN822-5D	Elbow	On each end of line	2
55	AN826-5D	Tee	On regulator	1
56	AN824-5D	Tee	On fwd end of line	1
	**AN815-5D	Union	On aft end of line	1
57	*AN822-5D	Union	On pressure signal	1

*On early C-47B airplanes only. **On late C-47B airplanes only. ††On very late C-47B airplane.

KEY TO FIGURES 651A, and 651B-FITTINGS—Continued

Item	*Part No.*	*Part Name*	*Remarks*	*No. Req*
59	**AN825-5D	Tee	On aft end of line at cylinder No. 3	1
	**AN912-1D	Reducer	On tee at oxygen cylinder No. 3	1
60	**AN827-5D	Cross	On fwd end of line	1
62	**AN824-5D	Tee	On fwd end of line	1
63	**AN822-5D	Elbow	On pressure gage	1
65	**AN815-5D	Union	On aft end of line	1
66	**AN824-5D	Tee	On aft end of line	1
	**AN815-5D	Union	On right end of line	1
68	**AN834-5D	Tee	On left end of line	1
	**AN924-5	Nut	On line	1
69	††AN823-5D	Elbow	On regulator	1
	††AN822-5D	Elbow	On flow indicator	1
70	††AN826-5D	Tee	On regulator	1
	††AN826-5D	Tee	On pressure gage	1
71	††AN815-5D	Union	On fwd end of line	1
72	††AN826-5D	Tee	On regulator	1

*On early C-47B airplanes only. **On late C-47B airplanes only. ††On very late C-47B airplane.

SECTION IX
CHARTS AND TABLES

1. INSTRUCTIONS FOR USING CABLE MANUFACTURING CHART.

a. The cable manufacturing chart on the following pages is provided to list information necessary for emergency manufacturing of any cable in these airplanes. (Refer to paragraph 2. of this section.) The cables in this chart are listed in numerical sequence regardless of the system in which the cable is used. Therefore, this chart should always be used in conjunction with the system drawings and parts lists covering the various systems of the airplane. For clarification, the cables in this chart are designated by type number. These type numbers refer to the drawing (figure 652) of the 13 typical cable types used in this airplane. Thus when looking for information on any cable, the type number should be noted and the drawing of typical types consulted. This will immediately show how the cable assembly should appear when completed. Listed under fitting "A" and fitting "C" is the type of end fitting to be used and fitting "B" shows the type fitting used where a cable assembly has a middle fitting. Lengths shown on this chart should always be compared with the drawing of the applicable type number on the drawing showing the various types. Listed below is an actual step-by-step procedure as it would be followed in finding the information necessary to replace a right-hand throttle cable. Information on any other cable may be obtained by following the same procedure.

(1) Assuming that the main throttle cable is broken, the first step is to consult the system drawing affecting the throttle controls (figure 231).

(2) This drawing (10, figure 231), shows that the right-hand main throttle cable is part No. 4114029-23. Note is also made that this is a cable assembly, consisting of two cables.

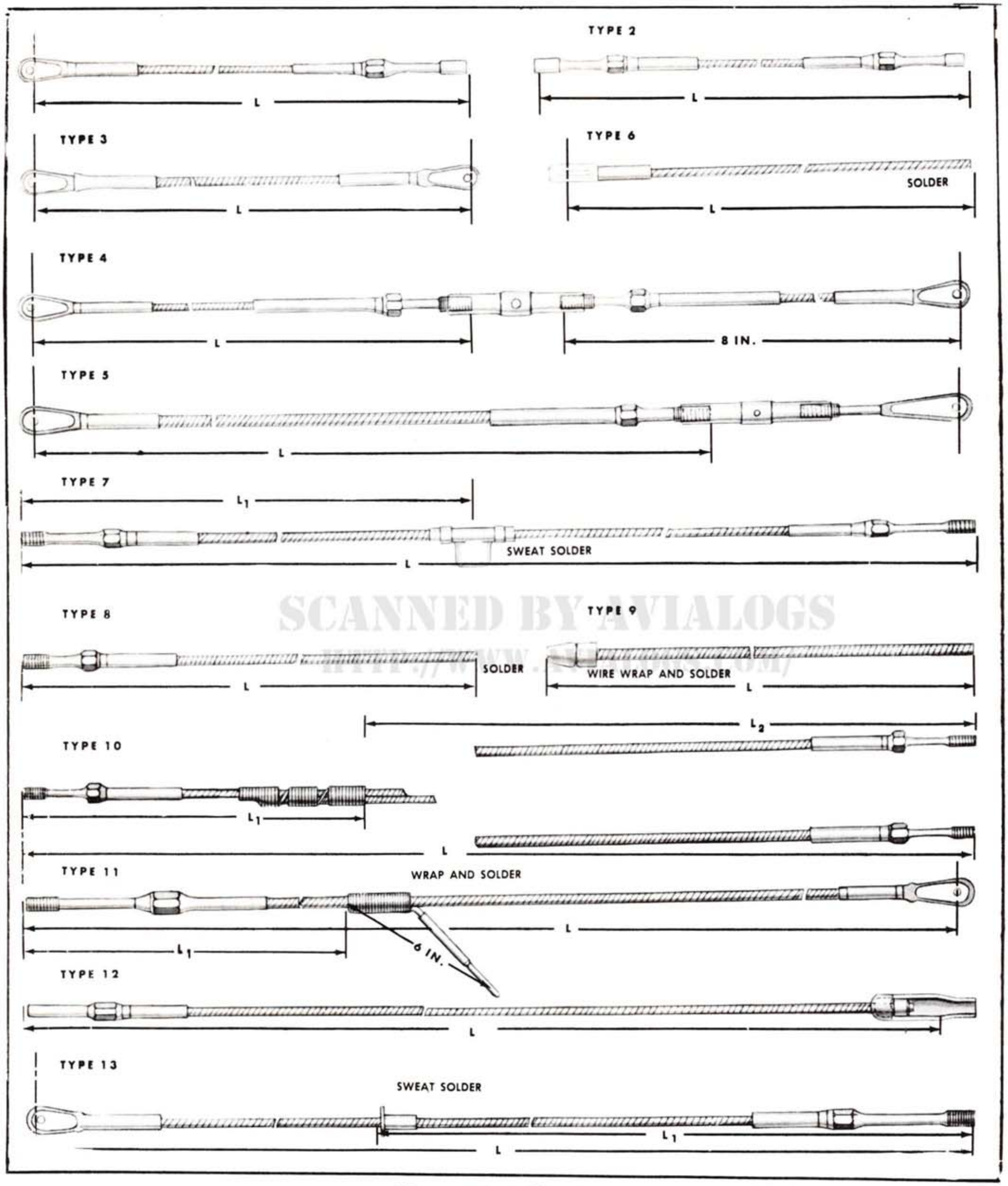

L
TYPE 2
L
TYPE 3
L
TYPE 6
SOLDER
L
TYPE 4
L
8 IN.
TYPE 5
L
TYPE 7
L_1
SWEAT SOLDER
L
TYPE 8
SOLDER
L
TYPE 9
WIRE WRAP AND SOLDER
L
L_2
TYPE 10
L_1
L
TYPE 11
WRAP AND SOLDER
L
L_1
6 IN.
TYPE 12
L
TYPE 13
SWEAT SOLDER
L_1
L

Figure 652—Cable Chart

(3 Turning to the cable manufacturing chart and looking up part No. 4114029-23, it is seen that this cable is a type 4.

(4) Consult the drawing showing the typical types (figure 652). Type 4 as shown on this drawing is a cable assembly consisting of two cables connected by a turnbuckle. There are clevis fittings on the extreme ends of the assembly. Dimension "L" is the over-

all length.

(5) With this information the cable manufacturing chart shows that the length of part No. 4114029-23 is 290¼ in. The material is 3/32 x 7 x 7 flex cable. Thus, it would follow that a piece of 3/32 x 7 x 7 flex 290¼ inches should be cut.

(6) As was noticed on the type drawing, this particular cable consists of two parts. The drawing shows that one of these lengths is 8 inches. Therefore, an 8-inch piece should be cut from the 290¼-inch piece previously cut.

(7) The cable manufacturing chart shows that fitting "A," and end fitting, is part No. 2049217-B-3. The type drawing shows this to be a clevis and fitting "A" is on the long cable.

(8) Fitting "C," the other extreme end of the assembly is a number 1116245 clevis.

(9) We now have one piece of cable 282¼ inches long, (290¼ x 8 inches) and a piece 8 inches long. Each of these pieces has a clevis fitting on one end. The drawing of type 4 shows these two pieces must be connected by a middle fitting.

(10) Fitting "B," the middle fitting on the chart, shows that the end of the long piece should be a 2049220-16DS-3R terminal. The end of the short piece should have a 2049220-16DS-3L terminal, and the two pieces should be joined by an AN155-16L turnbuckle.

(11) Thus, part No. 4114029-23 becomes a cable assembly 290¼ inches long with a turnbuckle fitting 8 inches from one end and clevis fittings on the extreme ends. This compares with the drawing of a type 4 cable.

(12) Section IV, paragraph 6.*e.*(2) gives a removal and installation procedure for throttle controls, and figure 336 gives a cable rigging chart which will show the proper tension to which the throttle cable should be rigged.

2. CABLE MANUFACTURING CHART. *(See figure 336.)*

Part No.	*Type*	*Fitting "A"*	*Fitting "B"*	*Fitting "C"*	*Cable Dimension*	*Length*
1117031-1	8	1028931L			3/32 x 7 x 7 flex steel	23-3/4
1117031-3	8	1028931R			3/32 x 7 x 7 flex	32-3/4
1117033	8	1028931R			3/32 x 7 x 7 flex	8-1/4
2074406-2-6-14100	1	2049216-10A2L		AN668-2	1/16 x 7 x 7 flex	141
2074406-3-0-54400	8	2049216-10A2R			1/16 x 7 x 7 flex	544
2074406-4-4-49700	2	2049220-8DS2L		2049220-8DS2L	1/16 x 7 x 7 flex	497
2074406-4-4-32330	2	2049220-8DS2L		2049220-8DS2L	1/16 x 7 x 7 flex	323-15/16
2074406-4-4-34616	2	2049220-8DS2L		2049220-8DS2L	1/16 x 7 x 7 flex	346-1/2
2074406-4-5-28616	2	2049220-8DS2L		2049220-8DS2R	1/16 x 7 x 7 flex	286-1/2
2074407-6-7-48800	2	2049219-16D3L		2049219-16D3R	3/32 x 7 x 7 flex	488
2074407-6-9-47912	13	2049219-16D3L	1396701 Stop	AN667-3	3/32 x 7 x 7 flex	L 479-3/8 $L_1$112-3/8
2074408-4-16-3802	12	2049220-21DS4L		1-160-ST4 Sleeve 1-162-SC4 Socket	1/8 x 7 x 19 flex	38-1/4
2074410-4-0-9212	1	2049220-46DS6L		2135994	3/16 x 7 x 19 flex	92-3/8
2074410-4-6-47904	2	2049220-46DS6L		2049219-46D6L	3/16 x 7 x 19 flex	479-2/16
2074410-4-6-50403	2	2049220-46DS6L		2049219-46D6L	3/16 x 7 x 19 flex	504-3/32
2074410-4-8-3412	1	2049220-46DS6L		2049217-B6	3/16 x 7 x 19 flex	34-3/8
2074410-4-8-5024	1	2049220-46DS6L		2049217-B6	3/16 x 7 x 19 flex	50-3/4
2074410-4-8-8916	1	2049920-46DS6L		2049217-B6	3/16 x 7 x 19 flex	89-1/2
2074410-6-6-48004	2	2049219-46D6L		2049219-46D6L	3/16 x 7 x 19 flex	480-1/8
2074410-6-6-48516	2	2049219-46D6L		2049219-46D6L	3/16 x 7 x 19 flex	485-1/2
2074410-6-6-53024	2	2049219-46D6L		2049219-46D6L	3/16 x 7 x 19 flex	530-3/4
2074410-6-8-8720	1	2049219-46D6L		2049218-C6	3/16 x 7 x 19 flex	87-5/8
2074410-6-8-8920	1	2049219-46D6L		2049218-C6	3/16 x 7 x 19 flex	89-5/8
2074410-6-8-11224	1	2049219-46D6L		2049218-C6	3/16 x 7 x 19 flex	112-3/4
2074410-6-8-11704	1	2049219-46D6L		2049218-C6	3/16 x 7 x 19 flex	117-2/16
2074410-6-8-15620	1	2049219-46D6L		2049218-C6	3/16 x 7 x 19 flex	156-5/8
2074410-7-0-9428	1	2049219-46D6R		2135994 special clevis	3/16 x 7 x 19 flex	94-7/8
2074410-7-0-12228	1	2049219-46D6R		2135994 special clevis	3/16 x 7 x 19 flex	122-7/8
2074410-7-8-2916	1	2049219-46D6R		2049217-B6	3/16 x 7 x 19 flex	29-1/2
2074410-7-8-5712	1	2049219-46D6R		2049217-B6	3/16 x 7 x 19 flex	57-3/8
2074410-7-8-5928	1	2049219-46D6R		2049217-B6	3/16 x 7 x 19 flex	59-7/8
2074410-7-8-10328	1	2049219-46D6R		2049217-B6	3/16 x 7 x 19 flex	103-7/8
2074410-7-8-1120	1	2049219-46D6R		2049217-B6	3/16 x 7 x 19 flex	112-1/4
2074410-7-9-12628	1	2049219-46D6R		2049218-C6	3/16 x 7 x 19 flex	126-7/8
2074410-7-9-15516	1	2049219-46D6R		2049218-C6	3/16 x 7 x 19 flex	155-1/2
2074410-7-9-16620	1	2049219-46D6R		2049218-C6	3/16 x 7 x 19 flex	166-5/8
2074410-7-9-16720	1	2049219-46D6R		2049218-C6	3/16 x 7 x 19 flex	167-5/8
2074410-8-8-8606	3	2049217-B6		2049217-B6	3/16 x 7 x 19 flex	86-3/16
2115277-2	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	32-1/2
2115277-4	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	38

Part No.	*Type*	*Fitting "A"*	*Fitting "B"*	*Fitting "C"*	*Cable Dimension*	*Length*
2115277-6	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	38
2115277-8	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	32-1/2
2115277-10	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	36-1/2
2115277-12	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	31-3/4
2115277-14	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	36-1/2
2115277-16	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	31-5/8
2115277-18	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	31-5/8
2115277-20	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	35-3/4
2115277-22	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	31-3/8
2115277-24	3	1116245		2049218-C-3	3/32 x 7 x 7 flex	35-7/8
2115350-4	2	2949220-8DS-2R		2049220-8DS-2R	1/16 x 7 x 7 flex	400
2115351-2	7	2049218-C-3	1116250 Stop	2049218-C-3	3/32 x 7 x 7 flex	L 245-1/2 $L_1$118
2115780-2	7	2049220-16DS-3R	1084939 Stop	2049220-16DS-3R	3/32 x 7 x 7 flex	L 27-1/4 $L_1$13-5/8
2115780-4	7	2049220-16DS-3R	1084939 Stop	2049220-16DS-3R	3/32 x 7 x 7 flex	L 72-3/4 $L_1$40-1/4
2116272-1	1	2049218-C-3		2049219-16D-3R	3/32 x 7 x 7 flex	121-5/8
2116272-3	1	2049218-C-3		2049219-16D-3R	3/32 x 7 x 7 flex	131-3/4
2116297-4	7	2049219-16D-3L	1116250 Stop	2049219-16D-3L	3/32 x 7 x 7 flex	L 54-3/4 $L_1$27-3/8
2116733-4	7	2049220-16DS-3L	1116250 Stop	2049220-16DS-3L	3/32 x 7 x 7 flex	L 134-1/4 L_1 71-1/2
2116733-5	7	2049220-16DS-3L	1116250 Stop	2049220-16DS-3L	3/32 x 7 x 7 flex	L 133-1/8 L_1 62-5/8
2117032-1	10	1028931L		1028931-L 1028931-L	3/32 x 7 x 7 flex	L 232 $L_1$121-1/2 $L_2$110-1/2
2117032-4	10	1028931L		1028931-L 1028931-L	3/32 x 7 x 7 flex	L 226 $L_1$110 $L_2$116
2118818	1	2049220-8DS-2L		1111636	1/16 x 7 x 7 flex	69-7/8
2118819-1	6	1111636			1/16 x 7 x 7 flex	130
2118819-3	6	1111636			1/16 x 7 x 7 flex	130
2118819-5	6	1111636			1/16 x 7 x 7 flex	130
2118927-6	2	2049220-16DS-3R		2049920-16DS-3R	3/32 x 7 x 7 flex	108
2118927-8	2	2049220-16DS-3R		2049220-16DS-3R	3/32 x 7 x 7 flex	104-1/2
2118995 and	11	2049219-16D-3R		1118470	3/32 x 7 x 7 flex	L 51-1/2
2118995-4				2049217-B-2	1/16 x 7 x 7 flex	$L_1$33-7/8
2118996	1	1116245		2049219-16D-3L	3/32 x 7 x 7 flex	115
2119150-4	2	2049220-16DS-3L		2049220-16DS-3L	3/32 x 7 x 7 flex	292
2119151-1	1	2049220-8DS-2L		1111636	1/16 x 7 x 7 flex	141
2119151-3	1	2049220-8DS-2L		1111636	1/16 x 7 x 7 flex	138
2143452-1	9	43A12443 Plug			1/16 x 7 x 7 flex	130
2143452-3	9	43A12443 Plug			1/16 x 7 x 7 flex	130
2143452-5	9	43A12443 Plug			1/16 x 7 x 7 flex	130
3115353-1	2	2049219-16D-3R		2049219-16D-3R	3/32 x 7 x 7 flex	335
4114029-3	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	297-1/2
4114029-5	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	292-5/8
4114029-7	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	291
4114029-9	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	295-1/4

Part No.	*Type*	*Fitting "A"*	*Fitting "B"*	*Fitting "C"*	*Cable Dimension*	*Length*
4114029-11	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	296-5/8
4114029-13	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	290-5/8
4114029-15	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3R	1116245	3/32 x 7 x 7 flex	297-1/2
4114029-17	4	2049217-B-3	2049220-16DS-3R AN155-16S 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	292
4114029-19	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	291-3/8
4114029-21	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	295-1/4
4114029-23	4	2049217-B-3	2049220-16DS-3R AN155-16L 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	290-1/4
4114029-25	4	2049217-B-3	2049220-16DS-3R 1203473 2049220-16DS-3L	1116245	3/32 x 7 x 7 flex	296-1/4
4114029-27	5	2049217-B-3	2049220-16DS-3L AN155-16S		3/32 x 7 x 7 flex	264-1/4
4114029-29	5	2049217-B-3	2049220-16DS-3L AN155-16S		3/32 x 7 x 7 flex	268-3/8
4114029-31	5	2049217-B-3	2049220-16DS-3L 1203473	1115518	3/32 x 7 x 7 flex	295-1/8
4114029-33	5	2049217-B-3	2049220-16DS-3L 1203473	1115518	3/32 x 7 x 7 flex	299-3/8
4114029-35	5	2049217-B-3	2049220-16DS-3L AN155-16S		3/32 x 7 x 7 flex	264
4114029-37	5	2049217-B-3	2049220-16DS-3L AN155-16S		3/32 x 7 x 7 flex	268-3/8
4114029-39	5	2049217-B-3	2049220-16DS-3L 1203473	1115518	3/32 x 7 x 7 flex	295-1/8
4114029-41	5	2049217-B-3	2049220-16DS-3L 1203473	1115518	3/32 x 7 x 7 flex	299-1/4
4115346-2	3	2049218-C-3		2049218-C-3	3/32 x 7 x 7 flex	104
4115347-2	3	2049218-C-3		2049218-C-3	3/32 x 7 x 7 flex	104
4115348-2	3	2049218-C-3		2049218-C-3	3/32 x 7 x 7 flex	107-5/8
4115349-2	3	2049218-C-3		2049218-C-3	3/32 x 7 x 7 flex	107-5/8

REQUIRED CABLE TURNS ON DRUM

Part No.	*Type*	*Required Turns*
2115350-3	2	12
2118927-6	2	3
2118927-8	2	3
2119150-4	2	3
3115353-1	2	9
4115346-2	3	2
4115347-2	3	2
4115348-2	3	2
4115349-2	3	2

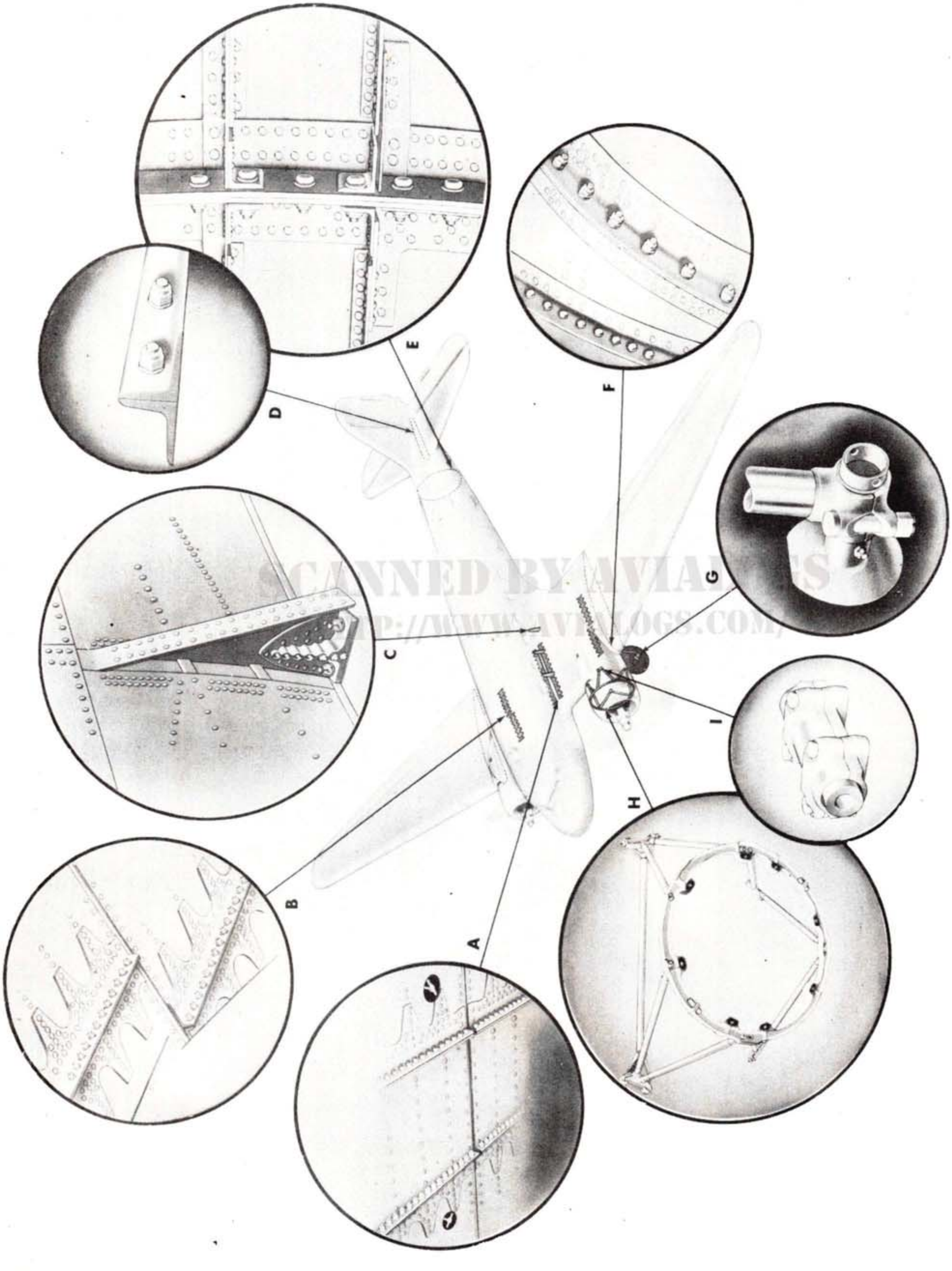


Figure 653—Torque Chart

3. SPECIAL TORQUE VALUES. *(See figure 653.)*

Item	*Name*	*Ref Dwg*	*Bolt*	*Torque (Inch-lbs)*
A	Inspection Covers (C/L of Airplane)	5116643 5113541	AN5-11A	110 (±10)
B	Fuel Tank Cover Attach Angles	5110506 5114634 5116315	AN5-11A	110 (±10)
*C	Fuselage Attachment to Center Wing at Spars	5110501	AN6-22, -23, -25	175 (+100, -0)
D	Attach Upper and Lower Sides of Horizontal Stabilizer Together at C/L of Airplane	5115207	AN3-6A	40 (±5)
E	Tail Stub Attach to Main Fuselage	5142179	AN5-7A, -10A, -12A	110 (±10)
F	Attach Angle—Inner to Outer Wing	5110501	**AN4-7A, -10A	100 (+0, -5)
G	Axle Clamp Bolt	Bendix 53926	7/8 Special	2160 (±240)
†H	Engine to Ring Attach at Lord Shock Mounts	5110572	AN8-41, -47	250 (+25, -0)
I	Engine Mount Attach to Fire Wall	1116576 1116575	AN5-35	125 (±15)
	Engine Mount Tube Attach to Engine Ring; Ring Halves Attachment	5110599	S-2076907, -15, -17, -20	400 (+40, -0)

---

*The excessive amount of plus tolerance on item "C" enables the cotter key to be installed in the fuselage pad stud bolt to safety the castelated nut and still stay within the torque tolerance.

†The torque value of item "H" will have to be checked by lifting the weight of the engine from the engine mount bolts.

**Specified torque should be applied regardless of the type of finish of the nuts or bolts. Stenciled instructions to the contrary on upper wing surface of some airplanes should be disregarded.

SECTION X

SERVICE INSPECTIONS, Page 722 through Page 764, Deleted. Refer to T. O. No. 01-40N-6

ALPHABETICAL INDEX

A Page

- Access and inspection provisions 10
- Ailerons 287
  - Trouble shooting 315
- Aileron controls 291
- Aileron tab control 302
  - Trouble shooting 316
- Air induction system, carburetor 160, 182
- Anti-icing systems 571
  (also see carburetor, propeller, and windshield anti-icer systems)
- Automatic pilot 264, 407
  - Bank-climb gyro control unit 268
  - Check valves 276
  - Emergency shut-off valve 276
  - Engaging lever 276
  - Follow-up cable assembly 277
  - Gyro control mount assembly 271
  - Hydraulic fluid drain trap 271
  - Hydraulic fluid filter 269
  - Hydraulic fluid pressure gage 269
  - Hydraulic fluid pressure regulator 270
  - Hydraulic system 407
  - Speed control valve assembly 272
  - Servo unit 272
  - Trouble shooting 284
  - Turn gyro control unit 268
- Auxiliary hydraulic feathering pump 202
- Axles, main wheel 121

B

- Bags 522
  - Canvas bags 522
  - Drop message bags 522
- Bail-out alarm bell 440, 455
- Battery system 424, 447
  - Batteries 424, 447
  - Battery cart receptacle 425
  - Battery connector relays 425, 447
  - Battery master switches 425, 448
  - Tests 425, 447
  - Trouble shooting 458
- Black-out curtains 516
- Blind flying hood 522
- Bonding, electrical 455, 641
- Booster coil 207
- Booster pumps, electric 240
- Brake hydraulic system 367
  - Actuating cylinder 374
  - Check valve 375
  - Control valve 367
  - Parking brake mechanism 376
  - Self-sealing couplings 376
- Brake, flight wheel 122
- Brakes, main wheel 115
  - Adjustments 119

Page

  - Assembly 121
  - Description 115
  - Disassembly 117
  - Inspection 757
  - Installation 121
  - Maintenance 118
  - Removal 117
- Bungee 107

C

- Cabin entrance step 517
- Cable manufacturing chart 717
- Canvas container 519
- Carburetor 164F
  - Adjustments 167
  - Description 164F
  - Maintenance 167
  - Removal 167
- Carburetor air induction system 160B, 182
  - Filters 164E
  - Motor for ram-nonram filtered type 454
  - Ram type 162
  - Ram filtered type 162
  - Ram-nonram type 162
  - Ram-nonram filtered type 164, 164E
- Carburetor air temperature gage 428, 448
- Carburetor anti-icer system 583
  - Check valves 586
  - Electric pump 584
  - Fluid filter 585
  - Lines 586
  - Manifold and distributor lines 586
  - Supply tanks 584
  - Pump motor 438, 453
- Cargo accommodations 613
- Cargo compartment, main 86
- Cargo door handle guard 517
- Charts and tables 715
- Charts, information 520
- Cleaning 638
- Collector ring 169
- Communications equipment 480, 491
  - Command radio set SCR-274-N 491
  - Command radio set SCR-522-( ) 499
  - Command radio set SCR-( )-183 480
  - Frequency meter set SCR-211-( ) 488, 496A
  - Glide path receiver 504E
  - Identification radio set SCR-595-( ) or SCR-695-( ) 490, 497
  - Interphone equipment RC-36 . . . . 496A
  - Interphone equipment RC-45 489
  - Liaison radio set SCR-287-A 496
  - Liaison radio set SCR-187-A 483
  - Marker beacon receiving equipment RC-43-( ) 496A

Page

  - Marker beacon receiving equipment RC-39-( ) 488
  - Radio compass SCR-269-G 486B, 496
  - Radio compass SCR-280-A 486
  - Radio compass AN/ARN-7 496A
  - Radio receiving equipment RC-103-( ) 504
  - Radio receiving equipment AN/ARR-1 504B
  - Radio set AN/APN-1 altimeter 504C
  - Radio set AN/APN-2 502
  - Radio set SCR-578-( ) 499
  - Radio set SCR-515- 490, 499
- Compasses 261
  - Ground swinging 261
  - Air swinging 263
  - Remote reading compass 450
- Control surfaces, settings and ranges of movement 5
- Control wheel mechanism 296
  - Adjustments 300
  - Description 296
  - Disassembly 297
  - Installation 302
  - Maintenance 300
  - Removal 297
- Covers, protective 32
- Cowl flaps 139
- Cowl flap hydraulic system 380
  - Actuating cylinder 383
  - Control valve 382
- Cowling 136
- Cross-feed valves 241
- Cylinders, engine 151

D

- Data holder 520
- De-icer shoes 561
  - Assembly 568
  - Description 561
  - Installation 568
  - Maintenance 567
  - Removal 561
- De-icing system 551
  - Air filter 558
  - Auxiliary valve 569
  - Check valves 555
  - Control system 560
  - De-icer shoes 561
  - Distributor valve 556
  - Drain cock 571
  - Oil separators 553
  - Lines 571
  - Pressure gage 560
  - Pressure relief valve 559
  - Surface de-icer distributor valve motor 438, 453
  - Vacuum pumps 551
- Dimensions, principal 1
- Drinking water provisions 512
- Dust excluder assemblies 519

E

- Electrical panels 413, 440
- Electrical system 413
  - Trouble shooting 455
- Electrical system, power plant 420, 442
- Electrical wiring 416, 441
  - Static grounds 420

Page

- Elevators 288
  - Trouble shooting 315
- Elevator controls 303
- Elevator tab controls 307
  - Trouble shooting 315
- Emergency accommodations 512
  - Black-out curtains 516
  - Emergency exits 512
  - First-aid kits 516
  - Folding ladder 514
  - Hand fire extinguisher 515
  - Life rafts 517
  - Safety belts 516
  - Safety belt rings 516
- Empennage 84
- Engines 142
  - Blower drain valve 154C
  - Covers 32, 517
  - Cylinders 151
  - Hoisting 18
  - Intake pipes 148
  - Oil system 154H
  - Pistons 154A
  - Push rods 147
  - Rocker arms and boxes 149
  - Superchargers, C-47, C-47A and C-47D 154D
  - Superchargers, C-47B 154D
  - Trouble shooting 160
  - Valves 154C
- Engine accessories 160B
- Engine controls 181
- Engine mount 136
- Engine primer system 168, 426, 448
  - Solenoid 244, 426
  - Switches 426
- Engine temperature gage 429, 449
- Equipment, miscellaneous 517
- Exhaust system 169
- Exhaust tail pipe 170
- Exits, emergency 512
- External power receptacle provisions 425

F

- Finish specifications 638
  - Cleaning 638
  - Control knob identification 641
  - Electrical bonding 641
  - Line identification 641
  - Protective finishes 639
  - Spot welding 641
  - Thread lubricant 641
- Fire Detection System 600C
  - Description 600C
  - Resistance Check 600C
  - Ground Test 600C
  - Polarity Test 600C
  - General Performance Test 600C
  - Detector Circuit Test 600C
  - Open Circuit Test 600C
  - Alarm Circuit Test 600C
- Fire extinguisher system, engine 522
  - Control panel assembly 524
  - Lux CO_2 cylinder and remote control valve assembly 523
- Fire extinguisher, hand 515
- First-aid kits 516
- Flame dampener 170, 519
- Flares, signal 624
- Flooring 511, 522, 601

Page
Free air temperature gage 428, 449
Fuel booster pump motor 448
Fuel, servicing with 35
Fuel quantity gage 246, 429, 450
Fuel system 228
    Booster pumps, electric 240
    Cross-feed valves 241
    Engine-driven fuel pump 245
    Engine primer solenoid 244
    Oil dilution solenoid 244
    Pressure gage line 244
    Quantity gage 429
    Selector valves 233
    Strainers 240B
    Tanks 36, 228
    Trouble shooting 247
    Wobble pumps 238
Fuel system, long-range 246
Furnishings 509
Fuselage 86
    Assembly 88
    Description 86
    Disassembly 88
    Hoisting 16
    Maintenance repair 88
    Removal 88

G

Generator system 420, 442
    Capacitor 423
    Control panels 421, 442
    Generators 420, 442
    Resistor 423, 447
    Reverse-current relay 422, 446
    Switches, main line 423, 447
    Trouble shooting 455
    Voltage regulators 422, 443
    Voltammeters 423, 447
Glider tow provisions 619
Ground handling 10
Ground operation instructions 67

H

Heater, auxiliary 548
Heating and ventilating system, hot air type 531, 541
    Controls and valves 541
    Ducts, flexible hose outlets 541, 545
    Electric emergency defrosting blower 546, 545
    Mixing valve assembly 536, 545
    Muff-type heat exchanger 536, 545
    Thermoswitches and warning lights 541, 546
    Trouble shooting 549
Heating and ventilating system, steam type 525
    Air eliminators 530
    Boiler 529
    Controls 529
    Outlets, ducts, lines, hose insulation 531
    Radiator 529
    Steam traps 530
    Steam pressure gage 530
    Steam pressure regulator 530
    Trouble shooting 548

Page
    Valves 530
    Water supply tank assemblies 528
    Windshield defrosting shields 531
Heat treated parts 626
Hoisting provisions 10
Hospital accommodations 602
Hydraulic system 319
    Check valves 346
    Clips and clamps 408
    Control panel 323
    Disconnect valves 345
    Engine-driven pumps 323
    Engine-driven pump selector valve 325
    Fluid reservoir 336
    Hand pump 338
    Hand pump to pressure accumulator
        shut-off valve 344
    Pressure accumulator 327
    Pressure gages 348
    Pressure regulator 330
    Pressure relief valve 338
    Supply, pressure and return system 319
    Tests 409
    Trouble shooting chart 410
    Tubing and flexible hoses 407

I

Ice elimination electrical units 437, 453
Ice elimination systems 551
Ignition, engine 170
Ignition harness and wiring 173
Ignition switch 180
Instrument chart 278
Instruments 248
    Automatic pilot 264
    Compasses 261, 450
    Main instrument panel 248
    Oil-pressure remote indicating systems 258
    Trouble shooting 282
    Pitot-static instruments 253
    Vacuum-operated instruments 255
Instruments, electrically operated 428, 448
Intake pipes, engine 148

J

Jacking provisions 18
Junction boxes 415, 441

L

Ladder, folding 514
Lamps 431, 451
    Compartment 433, 451
    Dome 431 451
    Formation 452
    Fluorescent 433, 451
    Instrument panel 433, 451
    Interaircraft signal 434, 451
    Landing 434, 451
    List 462
    Test 462
    Parachute pack rack 437, 453

Page

  - Passing 435, 452
  - Position 434, 452
  - Recognition 435, 452
  - Warning system 435, 452
- Landing gear bushing chart 132
- Landing gear hydraulic system 351
  - Actuating cylinder 356
  - Control valve 351
  - Hydraulic compensator 360
  - Shock absorber strut 361
- Landing gear, main 88
  - Adjustments 98
  - Axles 121
  - Brakes 115
  - Bungee 107
  - Flight wheel brake 122
  - Hydraulic compensator 109, 360
  - Hydraulic system 98, 351
  - Safety latch system 98
  - Shock absorber strut 105, 361
  - Signal system 123
  - Tires and tubes 122
  - Wheels 110
- Landing gear, tail wheel 123
  - Adjustment 130
  - Assembly 131
  - Description 123
  - Disassembly 125
  - Installation 131
  - Maintenance 126
- Lavatory 88, 509
- Leading particulars 1
- Leveling 35
- Life rafts 517
- Litter supports 602, 604
  - Metal-type 602
  - Strap-type 604
- Loading equipment 613
- Loading instructions, special 617
- Loading within weight and balance limits 620
- Lubrication requirements 41

M

- Magnetos 171
- Manifold pressure system 168
- Materials of construction 625
- Mixture controls 182
- Mooring 27

N

- Nacelles 136
- Name plates 520
- Navigation provisions 622
  - Navigator's compartment 622
  - Navigator's equipment 622
  - Navigator's stool 511
  - Navigator's table 511
- Non-ram carburetor air filter hydraulic system 403
  - Actuating cylinder 406
  - Control valve 405

Page

O

- Oil cooler shutter controls 221
- Oil dilution system 425, 448
  - Solenoid 244
  - Solenoid valve 425
  - Switches 426
- Oil grades 38
- Oil lines and connections 222
- Oil pressure gage 224
- Oil pressure relief valve 155
- Oil pressure remote indicating system 258
- Oil pressure transmitter 223
- Oil pump, main 155
- Oil separators, de-icer 553
- Oil, servicing with 38, 214
- Oil strainer 155
- Oil strainer bypass valve 155
- Oil sump 157
- Oil system 210
  - Draining 214
  - Filling 214
  - Trouble shooting 226
- Oil tanks 216
- Oil temperature gage 428, 449
- Oil temperature indicator 224
- Oil temperature regulator 216
- Oil thermostat 155
- Oxygen pressure, effect of temperature changes on 598
- Oxygen supply, duration of 599
- Oxygen system, high pressure 587
  - Cylinder assembly 587
  - Duration 599
  - Lines 589
  - Manifold pressure gage 587
  - Outlet valve 587
  - Recharging cylinder 589
  - Tests 589
- Oxygen system, low pressure constant flow 595
  - Cylinders 596
  - Duration 600
  - Instrument panel 596
  - Lines 598
  - Manifold assembly 598
  - Pressure gage 596
  - Regulators 596
  - Tests 600
  - Trouble shooting 600B
  - Warning signal assembly 596
- Oxygen system, low pressure demand 590
  - Cylinders 590
  - Demand regulator 594
  - Duration 599
  - Filling the cylinder 591
  - Flow indicator 594
  - Lines and connections 591
  - Portable apparatus 595
  - Pressure gage 594
  - Pressure signal 595
  - Tests 600
  - Trouble shooting 600B
  - Valves 593

Page

  - Warning signal lamp 595

P

- Parachute pack provisions 608
- Parachute pack release 438, 454
  - Auxiliary switch box 439
  - Control switches 439
  - Relays 440
  - Release mechanism 439
- Parking 24
- Parking brake mechanism 376
- Parts list, alphabetical 635
- Personnel accommodations 509
  - Carpeting 512
  - Drinking water provisions 512
  - Flooring 511
  - Fuselage lining 512
  - Lavatory 509
  - Navigator's stool 511
  - Navigator's table 510
  - Pilots' relief tubes 511
  - Pilots' seats 510
  - Radio operator's chair 511
  - Radio operator's table 510
- Pilot's compartment 86
- Pistol 623, 624
- Pitons, engine 153
- Pitot-static instruments 253
- Pitot tube heaters 431, 450
- Plug assembly, muff type 519
- Power plant 141
- Pressure relieve valve, hydraulic 338
- Propeller 185
  - Assembly 188
  - Covers 34
  - Description 186
  - Disassembly 186
  - Hoisting 18
  - Installation 188
  - Removal 186
  - Tests 195
  - Trouble shooting 204
- Propeller anti-icer system 579
  - Anti-icer pump motor 437, 453
  - Electric pump 580
  - Fluid filter 581
  - Lines 582
  - Shut-off valve 582
  - Slinger ring and distributor lines 582
  - Supply tank 580
- Propeller constant-speed control (governor) 195
  - Adjustment 199
  - Assembly 199
  - Disassembly 198
  - Description 195
  - Installation 199
  - Maintenance 198
  - Removal 198
- Propeller controls 203
- Propeller feathering system 426, 448
  - Auxiliary feathering pump 202
  - Feathering pump 426
  - Feathering relay 427
  - Feathering switches 426

Page

  - Pressure cut-out switch 427
- Propeller transporting equipment 606
- Push rods, engine 147
- Pyrotechnics 623
  - Pistol 623
  - Pistol mount 623
  - Pistol holder 624
  - Signal flare container 624
  - Signal flare ammunition 624

R

- Radio compartment 86
- Radio equipment (see Communications)
- Radio wiring diagrams 505
- Relief tubes 511
- Reverse-current relay 446
- Rigging (see Surface controls)
- Rocker arms and boxes 149
- Rocker box drain sump 157
- Rudder 290
  - Description 290
  - Hoisting 18
  - Installation 291
  - Maintenance 291
  - Removal 290
  - Trouble shooting 316
- Rudder controls 307
- Rudder pedal mechanism 311
- Rudder tab control 309

S

- Safety belts 516
- Safety latch system, mechanical 98
- Servicing instructions 35
- Shipment and erection procedure 5
- Shock absorber strut, main wheel 105, 361
- Shock absorber strut, tail wheel 124, 364
- Shock strut restraining link 21
- Shoring methods 23
- Spark plugs 180
- Stabilizer, horizontal 84
  - Hoisting 18
- Stabilizer, vertical 84
  - Hoisting 18
- Starter hand crank and gear box 517
- Starting system 207
  - Booster coil 207
  - Solenoid switches 207
  - Starters 207
  - Starter switches 207
- Static line 601
- Suit heat rheostats 455
- Surface controls 287, 291
  - Aileron controls 291
  - Aileron tab controls 302
  - Bushing chart 317
  - Control wheel mechanism 296
  - Elevator control 303
  - Elevator tab controls 307
  - Rudder controls 307
  - Rudder tab controls 309
  - Trouble shooting 315
  - Wing flap controls 312

Page
Surface control locks 25, 522

T

Tachometer 429, 450
Tail compartment 88
Tail cone 88
Tail wheel gear 123
  Bushing chart 135
  Shock strut 124, 364
Tail wheel guards 522
Tanks 216, 228
  Fuel 228
  Oil 216
Throttle controls 181
Tire and tube, tail wheel 130
Tires and tubes, main wheel 122
Tools, special 44
  Kits 520
Torque values, special 721
Towing 34
Transport provisions 601
Troop accommodations 601
Tubing charts 644
Turn and bank indicator 257

V

Vacuum operated instruments and equipment 255
Vacuum pumps 551
Valves, engine 153
Voltage regulators 422, 443
Voltammeters 423, 447

W

Wheels, main 110
  Adjustment 114
  Assembly 114
  Description 110
  Disassembly 113
  Installation 114
  Jacking 22
  Maintenance 113
  Removal 111
Wheel, tail 124
Windshield anti-icer system 571
  Front windshield unit 575
  Hand pump 573
  Shut-off valve 572
  Side windshield unit 573
  Solenoid pulsating unit 438, 453
  Supply tank 571
Windshield defrosters 522, 531
Windshield defroster motor 454
Windshield wiper hydraulic system 400
  Actuating units 403
  Control valve 402
Wing 73
  Assembly 80
  Covers 34
  Description 73
  Hoisting 17
  Jacking 19
  Installation 80
  Maintenance 80
  Removal 73
  Walkways 35
Wing flaps 291
  Controls 312
  Trouble shooting 316
Wing flap hydraulic system 389
  Actuating cylinder 394
  Control valve 393
  Indicating system 400
  Orifice check valve 399
  Relief valve 397
Wiring diagram 464, 505
Wobble pumps 238